

AD-A155 701 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 1/1
PLEASANT STREET DAM (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV JUN 79

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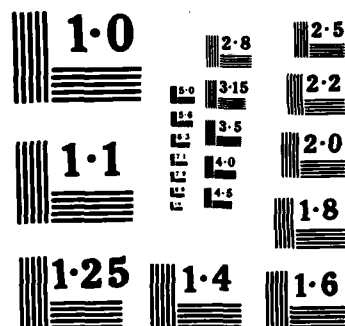
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AD-A155 701

MERRIMACK RIVER BASIN
DRACUT, MASSACHUSETTS

PLEASANT STREET DAM
MA 00838

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam consists of an about 93 ft. long stone masonry spillway with a brick building at each abutment. The dam is small in size with a hazard potential of significant. The overall condition of the dam can only be considered fair.		



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDED

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

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Dear Governor King:

Inclosed is a copy of the Pleasant Street Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, Goldcoff Realty, Inc., Methuen, Massachusetts.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely,


MAX B. SCHEIDER

Colonel, Corps of Engineers
Division Engineer

Incl
As stated

MERRIMACK RIVER BASIN
DRACUT, MASSACHUSETTS

PLEASANT STREET DAM

MA 00838

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JUNE 1979

PHASE I INVESTIGATION REPORT
NATIONAL DAM INSPECTION PROGRAM

Identification No.:	MA 00838
Name of Dam:	Pleasant Street
Town:	Dracut
County:	Middlesex
State:	Massachusetts
Date of Site Visit:	8 March 1979

BRIEF ASSESSMENT

Pleasant Street Dam consists of an approximately 93 ft. long stone masonry spillway with a brick building at each abutment. The spillway itself is approximately 15 ft. high and probably founded on bedrock. There is a 4 ft. square low-level gated outlet through the spillway structure and stoplogged conduit outlets through the building at the right abutment. Believed to have been built around 1850 to power textile mill equipment, the dam is not presently used by the owner.

Due to the extent of downstream development that would be affected in the event the dam were to fail, Pleasant Street Dam is confirmed as having a "significant" hazard potential in accordance with Corps of Engineers guidelines.

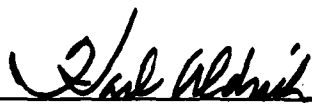
The overall condition of Pleasant Street Dam can only be considered fair, primarily because the spillway of the dam was obscured by heavily flowing water and the operation of the low-level outlet was not demonstrated. However, visible portions of the dam are generally in good condition, and the dam is performing adequately. There was no evidence of settlement, lateral movement or other signs of structural failure, or other conditions which would warrant urgent remedial action.

Based on the "small" size and "significant" hazard potential classifications in accordance with Corps of Engineers guidelines, the test flood for this dam is one-fourth the Probable Maximum Flood (1/4 PMF). Hydraulic analyses in-

dicade that the test flood outflow of 20,300 cfs (inflow 21,900 cfs or 237 csm) would occur with an upstream water surface elevation about 16.2 ft. above the top of dam (equal to a 20 ft. spillway surcharge). With the water level 3.8 ft. above the spillway crest, corresponding to the estimated top of dam level, the spillway capacity is approximately 2,500 cfs, which is 12 percent of the test flood outflow.

Goldcoff Realty, Inc., owner of the dam, should engage a registered professional engineer to observe and assess the condition of the spillway, outlets and gate platform supports at a time of low flow and also assess the structural stability of the dam under earthquake loading conditions, as outlined in Section 7.2. These engineering investigations, any necessary modifications resulting from the investigations, and remedial measures, including preparing a formal operations and maintenance manual for the dam and establishing a written emergency preparedness plan and downstream warning system, should be implemented by the owner within one year after receipt of this report.

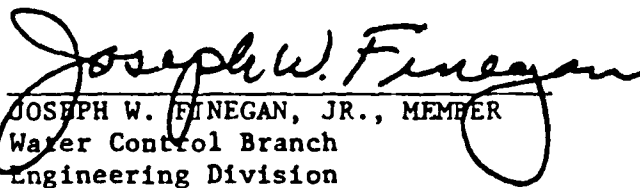
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by:

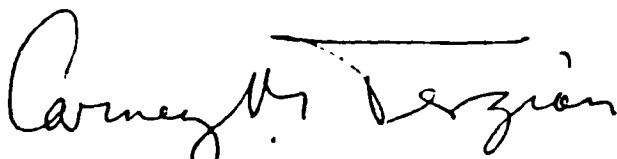


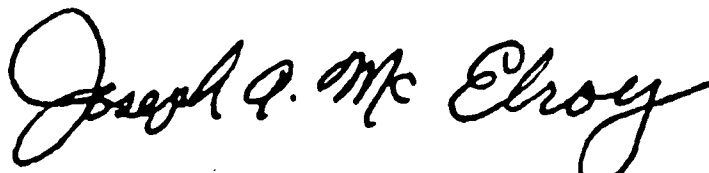
Harl Aldrich
President



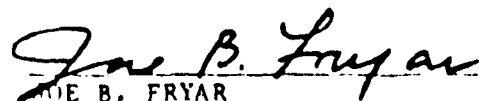
This Phase I Inspection Report on Pleasant Street Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.


JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division


CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division


JOSEPH A. MCELROY, CHAIRMAN
Chief, NED Materials Testing Lab.
Foundations & Materials Branch
Engineering Division

APPROVAL RECOMMENDED:


JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the office of Chief of Engineers, Washington, DC 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "probable maximum flood" for the region (greatest reasonably possible storm run-off), or a fraction thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential. Consideration of downstream flooding other than in the event of a dam failure is beyond the scope of this investigation.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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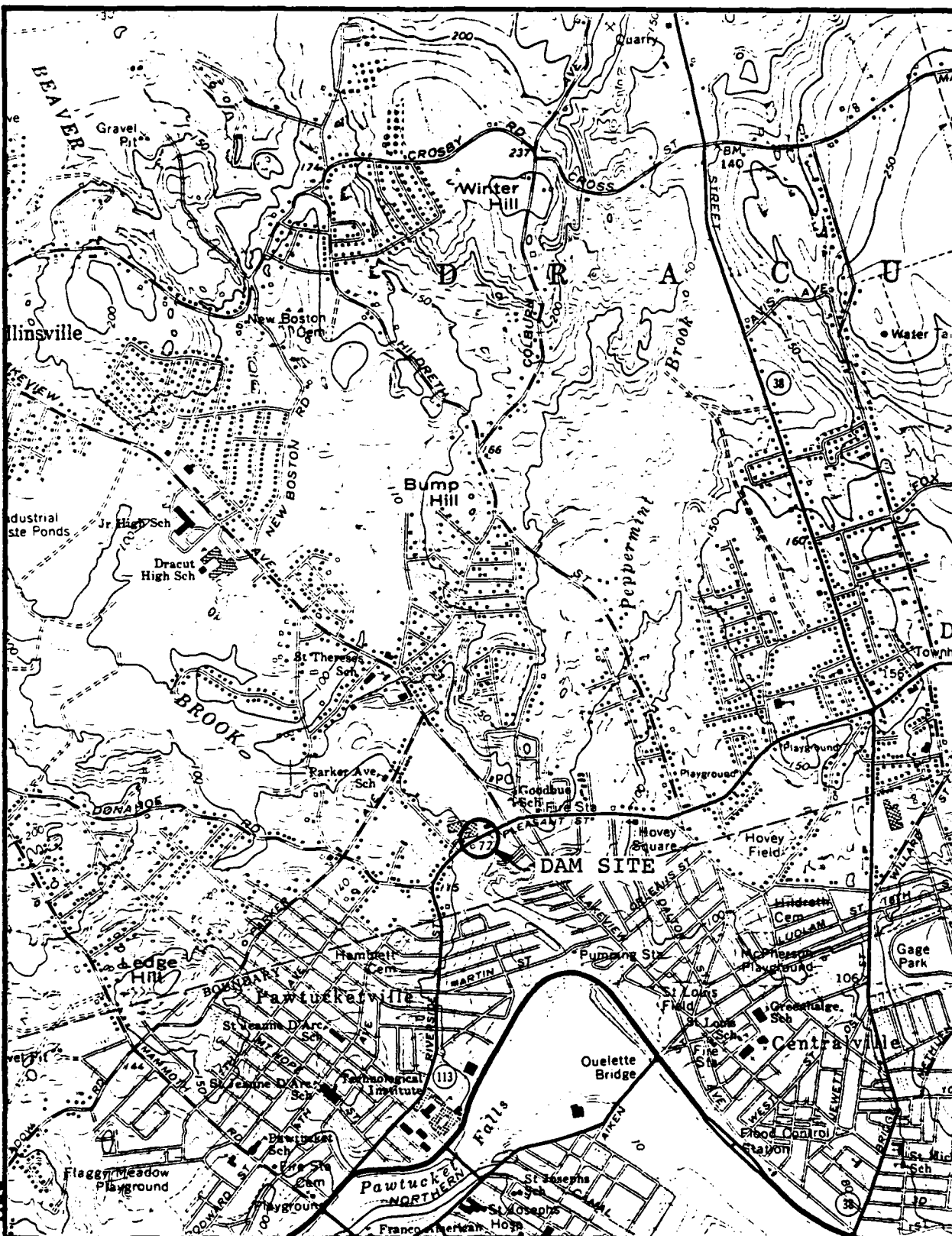
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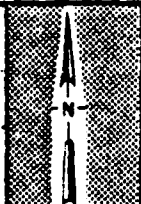


1. Overview of Pleasant Street Dam

FILE NO. 4270 A22



DAM: PLEASANT STREET
IDENTIFICATION NO. MA 00838



LOCATION MAP
USGS QUADRANGLE
LOWELL, MA
APPROX. SCALE: 1" = 2000'

PHASE I INVESTIGATION REPORT
NATIONAL DAM INSPECTION PROGRAM
PLEASANT STREET DAM
MA 00838

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region.

Haley & Aldrich, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed were issued to Haley & Aldrich, Inc. under a letter dated 28 November 1978 from Colonel Max B. Scheider, Corps of Engineers. Contract No. DACW33-79-C-0018 has been assigned by the Corps of Engineers for this work. Camp, Dresser & McKee, Inc. was retained as consultant to Haley & Aldrich, Inc. on the structural, mechanical/electrical and hydraulic/hydrologic aspects of the Investigation.

b. Purpose of Inspection. The primary purposes of the National Dam Inspection Program are to:

1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and prepare the states to initiate effective dam safety programs for non-Federal dams.

3. Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Pleasant Street Dam spans Beaver Brook immediately upstream of Pleasant Street in Dracut, Massachusetts, as shown on the Location Map, page vii. The approximate coordinates of the dam site are N 42° 39.9' and W 71° 19.4'. Beaver Brook joins the Merrimack River in Lowell approximately 3000 ft. downstream of the dam.

b. Description of Dam and Appurtenances. The dam consists of a gravity-type stone masonry overflow spillway structure approximately 93 ft. in length, with a gated low-level outlet near its base. The vertical downstream face is approximately 15 ft. in height. The width of the weir and the slope of the upstream side are unknown. The dam is abutted by brick buildings on either side, and is apparently founded on the bedrock formation that is exposed in the downstream channel. At the right abutment there is a stop-logged intake structure which supplies a conduit system that outlets from the building along the right side of the downstream channel. The general configuration of the dam is shown on the "Site Plan Sketch", page C-1.

c. Size Classification. Pleasant Street Dam has an estimated storage capacity of 140 acre-ft. at the top of the dam, which appears to be the level above which the right bank of Beaver Brook upstream of the dam would be overtopped and a few homes on the left bank below Parker Street would be flooded. The corresponding hydraulic height of the dam is about 18.8 ft. According to guidelines established by the Corps of Engineers, storage capacity of less than 1000 acre-ft. and a height of less than 40 ft. place this dam in the "small" size category.

d. Hazard Classification. Based on the Phase I investigations and dam failure analyses (Section 5.1f), in accordance with Corps of Engineers guidelines, Pleasant Street Dam was found to have a "significant" hazard potential. If the dam were to fail, a plant, an office building, and a machinery parking and equipment storage area of an asphalt manufacturing company could be subject to serious flooding. The potential for loss of a few lives and appreciable damage to the industrial property and roads is significant.

e. Ownership. The name and address of the current owner of the dam and the building at the right abutment are Goldcoff Realty, Inc., 102 Pleasant Valley Street, Methuen, MA 01844. Mr. Robert Goldman is President of Goldcoff Realty, Inc., and his business telephone number is (617) 685-0333.

The property was purchased by the current owner from Bobco Associates of Dracut, MA, on 1 December 1978. Bobco Associates had bought the property from J.P. Stevens in 1971. Other firms have undoubtedly owned the dam in the years since its original construction.

f. Operator. Mr. David Fisher is head of maintenance for Goldcoff Realty, Inc., and Mr. Jerry Gagney is the maintenance man for the building located at the right abutment of the dam. Mr. Gagney has been responsible for the routine operation, maintenance and safety of the dam since about 1965. He can be contacted at the dam site through the office of a tenant in the building, Beauty Box, Inc., at telephone number (617) 957-3136.

g. Purpose of Dam. The dam was evidently once used to supply power to adjoining mills. These buildings are no longer textile mills, and the dam currently serves no useful purpose other than to raise the level of Beaver Brook upstream of the dam. The present owner of the dam, Goldcoff Realty, Inc., has expressed an interest in generating hydroelectric power at the dam site, if such an operation can be proven to be technically and economically feasible.

h. Design and Construction History. There are no design or construction records available to document when, how and by whom the original dam was built. It is likely that the dam was built around the year 1850, considering that numerous mills were utilizing water power in the Lowell area in the mid-1800's.

i. Normal Operational Procedures. There is no formal established routine for the operation of the dam. The gate for the 4 ft. by 4 ft. outlet at the bottom of the dam (invert El. 57.2) is opened at the request of the downstream residents through authorization by the State for periods of time during low summer flows in order to flush out stagnant conditions downstream.

1.3 Pertinent Data

All elevations reported herein are approximate and are based on rough measurements made at the dam site. The elevations are in ft. above National Geodetic Vertical Datum (NGVD), measured relative to a point on the Pleasant Street Bridge assumed to be at El. 76.0 NGVD, as shown on an engineering plan (for an unrelated project), page B-8.

a. Drainage Area. Beaver Brook is a tributary to the Merrimack River. The total drainage area of the brook above

Pleasant Street Dam is estimated to be 92.4 square miles, as shown on the Drainage Area Map, page D-1. Ground elevations in the 22 mile long watershed vary from a low of about El. 76 near the dam to a high of about El. 639 in Chester, New Hampshire. About 10 percent of the area consists of lakes, ponds and swamps. The remaining part consists of rolling woodlands and residential areas. Most of the residential area is located near Derry, New Hampshire, in the northernmost region of the drainage area, and near Dracut, Massachusetts, in the southernmost region of the drainage area.

b. Discharge at Dam Site.

1. Outlet works.....4 ft. by 4 ft. outlet gate at invert El. 57.2 (est.) controlled from a platform extending from the right abutment
2. Maximum known flood at dam site.....Not available
3. Ungated spillway capacity at top of dam.....2,500 cfs at El. 76.0
4. Ungated spillway capacity at test flood pool elevation.....10,300 cfs at El. 92.2
5. Gated spillway capacity at normal pool elevation.....Not applicable
6. Gated spillway capacity at test flood pool elevation.....Not applicable
7. Total spillway capacity at test flood pool elevation.....10,300 cfs at El. 92.2
8. Total project discharge at test flood pool elevation..20,300 cfs at El. 92.2 (extreme overland flow on left bank extending to and including Lakeview Avenue)

c. Elevation (ft. above NGVD)

1. Streambed at centerline of dam.....57.2
2. Maximum tailwater.....Unknown
3. Upstream portal invert diversion tunnel.....Not applicable
4. Normal pool.....72.2

5. Full flood control pool.....Not applicable
6. Spillway crest.....72.2
7. Design surcharge -
original design.....Unknown
8. Top of dam.....76.0 (assumed)
9. Test flood design
surcharge.....92.2

d. Reservoir

1. Length of maximum pool.....1.0 mi. (Est.)
2. Length of normal
pool.....0.6 mi. (Est.)
3. Length of flood control
pool.....Not applicable

e. Storage (acre-feet)

1. Normal pool.....80
2. Flood control pool.....Not applicable
3. Spillway crest.....80
4. Top of dam.....140
5. Test flood pool.....1830

f. Reservoir Surface (acres)

1. Normal pool.....12
2. Flood control pool.....Not applicable
3. Spillway crest.....12
4. Top of dam.....20
5. Test flood pool.....200

g. Dam

1. Type.....Stone masonry
spillway overflow
2. Length.....93 ft.
3. Height.....18.8 ft.
4. Top width.....Unknown
5. Side slopes.....D/S vertical,
U/S unknown
6. Zoning.....Not applicable
7. Impervious core.....Not applicable
8. Cutoff.....Unknown
9. Grout curtain.....Unknown

h. Diversion and Regulating Tunnel. Not applicable

i. Spillway

1. Type.....Stone masonry overflow
2. Length of weir.....93 ft.
3. Crest elevation.....72.2
4. Gates.....None
5. U/S channel.....River channel
6. D/S channel.....River channel -
turbulent flow caused
by remnants of a
building foundation
immediately downstream
of dam, which splits
flow into two
separate channels

j. Regulating Outlets. There is a 4 ft. by 4 ft. outlet near the base of the dam, which can be used to lower the water level behind the dam. The outlet gate is manually operated by a rack and pinion mechanism with worm gear wheel which is mounted on a wooden platform about 23 ft. from the right intake structure, Photo No. 6. The invert of the gate is estimated to be at El. 57.2.

Water from the river was once used by the old mill for generating power by means of three inlets in an intake structure on the right side of the dam, Photo No. 7. The middle and left inlets are 5.5 ft. wide by 6.0 ft. deep and the right intake is 2.5 ft. wide by 6.0 ft. deep. The invert of the intakes is El. 67.2. There are apparently no gates, although there are indications that submerged stoplogs are in place at the three intake openings. The top of the stoplogs is estimated to be at El. 72.0. The conduits reportedly exit downstream through the side of the building.

SECTION 2 - ENGINEERING DATA

2.1 Design Data

No design data for the original dam were located.

2.2 Construction Data

No information regarding the construction of the dam was disclosed.

2.3 Operation Data

No operational records for this dam were disclosed.

2.4 Evaluation of Data

a. Availability. The limited engineering data available for use in preparing this report are listed on page B-1. Copies of the documents from the listing are also included in Appendix B.

b. Adequacy. There was a lack of engineering data available to aid in the evaluation of Pleasant Street Dam. This Phase I assessment was therefore based primarily on visual examination, preliminary hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement.

c. Validity. The limited information contained in the available data may generally be considered valid.

SECTION 3 - VISUAL EXAMINATION

3.1 Findings

a. General. The Phase I visual examination of Pleasant Street Dam was conducted on 8 March 1979. The upstream water surface elevation was extremely high that day, about 2.5 ft. above the spillway crest. The overall condition of the dam can only be considered fair due to the uncertainty of the condition and dimensions of those portions obscured by water flow. However, visible portions of the project were found to be in good condition and deficiencies which require correction were noted.

A visual inspection check list is included in Appendix A and selected photographs of the project are given in Appendix C. A "Site Plan Sketch", page C-1, shows the direction of view for each photograph.

b. Dam. The dam consists of a stone masonry spillway structure which was completely obscured by flowing water at the time of the site visit, Photo No. 1. Therefore, it was not possible to observe the spillway structure for seepage, missing stones, loss of mortar and other structural deficiencies. However, there was no evidence of lateral movement or distress in the spillway when viewed along its axis, Photo No. 2. The downstream face of the spillway is shown on Photo No. 3 at a time of lower flow to indicate the type of stone masonry construction utilized. The brick building walls on stone masonry foundations at the left and right abutments of the dam, Photos No. 4 and 5, are in good condition.

c. Appurtenant Structures. The following specific items were noted regarding the outlet works at the dam site:

1. The access walkway to the low-level outlet gate control platform and the wooden platform, Photo No. 1, are in good to fair condition. Some of the platform boards had loosened up over the winter and/or during high flows, Photo No. 6. The Operator indicated this to be a routine problem. The platform appears to be supported by

wood piles, Photo No. 3, which were not visible at the time of the March visit.

2. The gate is manually operated utilizing a rack and pinion device with a worm gear wheel which is in good condition, Photo No. 6. The low-level outlet gate was reported to be operational, but its operation was not demonstrated during the site visit.
3. The concrete intake structure right of the dam, Photo No. 7, is in good to fair condition. The date inscribed in the concrete indicates that this intake was probably rebuilt in 1945. There are three unprotected openings in the top slab of the intake which appear to be openings for gates and stoplogs, although gates were not observed. There are, however, indications that stoplogs were in place.
4. There are no handrails around the gate control platform, Photo No. 6, and the intake structure, Photo No. 7.
5. A second opening in the slab over the third inlet of the intake near the building was grated over. An additional opening was planked over and not opened during the inspection. The condition of the planks was good to fair, Photo No. 7.

d. Reservoir Area. Beaver Brook is confined by brick industrial buildings immediately upstream of the dam. Further upstream, the shoreline is generally wooded, Photos No. 1 and 4, and homes, roads and other urban development are present. There is no significant probability of landslides into the pond affecting the safety of the dam. Sedimentation has probably occurred to some degree on the upstream side of the dam, but was not reported to be a problem.

e. Downstream Channel. Beaver Brook joins the Merrimack River at a distance of about 3,000 ft. from the dam site. A section about 1,000 ft. in length immediately downstream of the dam is within the Town of Dracut, and the remaining 2,000 ft. is within the City of Lowell.

A bridge with two semi-circular openings, each about 24 ft. wide at the base and about 16 ft. high at the center, is located at Pleasant Street about 50 ft. downstream of the dam, Photos No. 8 and 9. Flow upstream of the bridge was very turbulent due to remnants of a building foundation located just downstream of the spillway, Photos No. 1 and 9.

The brook bends in a southwesterly direction starting at a point about 500 ft. downstream of Pleasant Street. Peppermint Brook, which drains the Dracut Town Center Area, flows into Beaver Brook approximately at the mid-point of the bend. An asphalt plant is located adjacent to Peppermint Brook at its confluence with Beaver Brook near the end of Brookside Avenue in Dracut. The channel width in this vicinity is about 100 ft. A growth of small and medium size trees was observed in the stream bed.

The channel passes under a bridge on Martin Street at a distance of about 2,400 ft. from the dam site. This bridge is of single span steel construction about 93 ft. in length. The bridge decking is made of steel gratings. The total channel depth, below the lower end of the bridge beam, is about 10 ft.

Developments, primarily residential and a few industrial, were observed, particularly along the left bank within Dracut and along both banks in Lowell.

3.2 Evaluation

Based on visual observations during the site examination, the general condition of the project can only be considered fair since the major portion of the dam could not be observed. It is recommended that a further examination be made at a time when there is low flow to observe the condition of the spillway (main dam), the downstream apron, outlets, and the supports for the outlet gate control platform. Visible portions of the dam appear to be generally in good condition, and the dam is performing satisfactorily. The noted deficiencies relate primarily to items affecting the safety of the operator.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

In general, there are no formal procedures to provide routine maintenance and satisfactory operation of the dam. The only informal procedure reported was opening the low-level outlet gate upon request of the State during periods of low flow, usually for only a few days in the summer.

4.2 Maintenance of Dam

There are no established procedures or manuals for inspection and maintenance of the dam.

4.3 Maintenance of Operating Facilities

There is no established maintenance program for the operating facility. The operator indicated that the control mechanism and platform for the outlet are diligently maintained, while any other routine maintenance is on a demand basis. The outlet gate is reportedly opened every summer, although its operation was not demonstrated during the site visit.

4.4 Description of any Warning System in Effect

There is no warning system or emergency preparedness plan in effect for this structure.

4.5 Evaluation

The owner should prepare an operations and maintenance manual for the dam. The manual should delineate the routine operational procedures and maintenance work to be done on the dam to provide satisfactory operation and minimize deterioration of the facility. For example, an annual observation and maintenance program should be established to examine the dam, clear debris from the spillway weir and maintain outlets, walls and channels. Incorporated in this manual should be a procedure to operate the reservoir drain periodically.

Since failure of the dam would possibly cause loss of life and significant property damage downstream, the owner should also prepare and implement a formal emergency preparedness plan and warning system.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General. The dam is of stone masonry construction. The original purpose of the dam was to provide water storage and regulation for generating power at the adjacent mill buildings. Now the dam serves no purpose other than control of upstream water levels and occasional flushing of the downstream channel during the dry season through a low-level outlet located near the base of the spillway structure. Significant spillway discharge is seasonal and usually occurs during the early spring. The dam is basically a run-of-river type.

The relatively long length of the drainage basin and the existing ponds, lakes and swamps within will have the effect of reducing the intensity of any flood flows.

b. Design Data. No hydrologic or hydraulic design data were available for the dam.

c. Experience Data. No records of maximum flows were available for Pleasant Street Dam. During the site visit on 8 March 1979, the water level in the brook was nearly flush with the top of the concrete intake structure at approximately El. 74.7.

d. Visual Observations. The 93 ft. long spillway structure extends between two former mill buildings along Beaver Brook just upstream of Pleasant Street. About 2.5 ft. of water was flowing over the spillway on the day of the site visit. The flow at the toe of the dam was very turbulent because of flow around an old foundation wall at the center of the channel and against a building wall at the right bank, both being just a few feet away from the dam. The existing three water inlets to the mill building on the right bank were partially blocked with stoplogs. Access to the control for the low-level outlet gate is by a footbridge about 23 ft. in length from the right abutment.

Flow under the Pleasant Street Bridge is through two semi-circular openings. The upstream face of the bridge is of stone masonry, Photos No. 8 and 9, and the downstream face is of concrete construction, Photo No. 10.

The downstream channel below Pleasant Street is divided

longitudinally into two sections with an about 6 ft. high stone masonry wall extending from the center pier of the bridge for a distance of about 50 ft. downstream, Photos No. 10 and 11. A dense growth of various size trees was observed near the centerline of the channel.

The right bank consists of woodlands in Dracut and residential areas in Lowell. An about 5 ft. high earth-fill dike on this bank protects the residential areas in Lowell against the high stages of the brook. The left bank in Lowell is protected against floods by a concrete wall extending 800 ft. upstream from the Martin Street bridge. A freeboard of only about 1.5 ft. was available underneath the steel beam of the Martin Street bridge at the time of the site visit.

Relatively low flatlands along the brook are located at the confluence of Peppermint Brook with Beaver Brook. Here an asphalt plant and a dwelling are located.

e. Test Flood Analysis. Based upon the Corps of Engineers guidelines, the recommended spillway test flood for "small" size dams having a "significant" hazard potential is within the range of 100-yr. flood to 1/2 PMF (Probable Maximum Flood). The PMF was determined using Corps of Engineers Guidelines for Estimating Maximum Probable Discharge in the Phase I Dam Safety Investigations. The watershed terrain was determined to be 90 percent rolling and 10 percent flat (swamp and water surface). From this, an inflow rate of 949 cfs per square mile was interpolated for the drainage area of 92.4 square miles. The resulting PMF inflow is 87,700 cfs.

It is not possible within the scope of this investigation to determine the effects of the various hydrological factors on the drainage area of Pleasant Street Dam. However, for the purposes of this study, it was assumed that the test flood will be 1/4 PMF, which is calculated to be 21,900 cfs.

Surcharge-storage routing was performed through Pleasant Street Pond using the stage-discharge and area-volume curves shown in Appendix D. The test flood outflow, estimated to be 20,300 cfs, would occur when the water surface elevation in the pond is at El. 92.2. This is 16.2 ft. above the top of dam elevation or about 20 ft. above the spillway crest. A preliminary study of

the downstream channel hydraulics, Appendix D, indicates that the tailwater would be at El. 82.2, and that a large area both downstream and upstream of the dam would be flooded. The spillway capacity is about 2,500 cfs or about 12 percent of the test flood outflow with the water level at the assumed top of dam, El. 76.0. At an upstream water level of El. 76, it appears that the right bank of Beaver Brook would be overtopped and a few homes on the left bank below Parker Street would begin to flood.

f. Dam Failure Analysis. Based on Corps of Engineers Guidelines for Estimating Dam Failure Hydrographs and assuming that a failure would occur along 90 percent of the dam length, the peak failure outflow is estimated to be 11,470 cfs. Prior to failure, the flow would be approximately 2,400 cfs, all contained within the channel to the Merrimack River.

A low lying area on the left bank near the confluence of Peppermint Brook with Beaver Brook would be flooded with water depths varying from 2 to 4 ft. An asphalt plant with its office building and a machinery parking lot in the vicinity would be affected by the failure flood. The Pleasant Street Bridge, however, is not expected to be overtopped either before or after a dam failure.

Thus, a potential for loss of a few lives and appreciable industrial property damage are considered to exist at this dam site and the dam is classified as having a significant hazard potential, in accordance with Corps of Engineers guidelines.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. There is no evidence that movement or distress was present in the dam. However, the spillway was obscured by flowing water. With an observed flow of about 2.5 ft. of water over the spillway crest with no major movement or distress evident, the spillway structure was apparently structurally stable under the observed loading conditions during the time of investigation.

b. Design and Construction Data. No design data or construction plans were located for this dam. Since the geometry (cross-section) of the main dam is not known, it is not possible to determine structural stability under static loading conditions.

c. Operating Records. No operating records other than one state inspection report were located.

d. Post-Construction Changes. The 1945 date inscribed in the concrete intake indicates this structure may have been rehabilitated after the dam was constructed. The operator indicated during the investigation that the dam had been repaired some 12 years ago, but no record of this repair was disclosed.

e. Seismic Stability. Pleasant Street Dam is located in a Seismic Zone 3. In accordance with Recommended Phase I Guidelines, suitable analyses made by equivalent static load methods should be on record for this dam. No such analyses have been made. Therefore, the stability of the dam during an earthquake is unknown.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The overall condition of Pleasant Street Dam can only be considered fair because most of the structure was obscured by flowing water. However, visible portions of the dam were generally in good condition. There were no signs of impending structural failure or other conditions which would warrant urgent remedial action. Several deficiencies concerning the safety of the operator were noted.

Based on the results of computations included in Appendix D and described in Section 5, the spillway is not capable of passing the test flood, which for this structure is the 1/4 PMF, without overtopping the banks of Beaver Brook upstream of the dam. The test flood outflow of 20,300 cfs (inflow 21,900 cfs or 237 csm) would reach a level 16.2 ft. above top of dam or about 20 ft. above the spillway crest. With the water level at the top of dam, considered to be 3.8 ft. above the spillway crest, the spillway capacity is about 2,500 cfs, which is 12 percent of the test flood outflow.

b. Adequacy of Information. This evaluation of the dam is based primarily on visual examination, preliminary hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement. The information available or obtained was not adequate to make a complete assessment. Therefore, it is recommended that additional information regarding the condition of portions of the dam and its structural stability under earthquake loading conditions be obtained, as outlined in Section 7.2.

c. Urgency. The recommendations for additional investigations and remedial measures outlined in Section 7.2 and 7.3, respectively, should be undertaken by the Owner and completed within one year after receipt of this report.

d. Need for Additional Investigation. Additional investigations should be performed by the Owner as outlined in Section 7.2.

7.2 Recommendations

It is recommended that Goldcoff Realty, owner of the dam, engage a registered professional engineer to undertake the following investigations:

1. Observe and assess the condition of the spillway structure, outlets and gate control platform supports at a time when there is little or no flow over the spillway. The feasibility of raising the wooden gate control platform or otherwise modifying it in order to reduce the reported maintenance problem should be included in this study.
2. Assess the potential for a failure of the dam under earthquake loading conditions for Seismic Zone 3 by conventional equivalent static load methods. To perform the required analysis, a determination of the dam's configuration and construction materials will be necessary.

The Owner should then implement any necessary corrective measures on the basis of this engineering evaluation.

7.3 Remedial Measures

Since the spillway structure was obscured by heavy flow, few specific deficiencies were noted.

a. Operation and Maintenance Procedures. The following should be undertaken by the Owner:

1. Prepare a formal operations and maintenance manual for the dam. The manual should include provisions for annual technical inspection of the dam and for round-the-clock surveillance of the dam during periods of heavy precipitation and high project discharges. The procedures should delineate the routine operational procedures and maintenance work to be done on the dam to ensure safe, satisfactory operation and to minimize deterioration of the facility.
2. Develop a written emergency preparedness plan and warning system to be used in the event of

impending failure of the dam or other emergency conditions. The plan should be developed in cooperation with local officials and downstream inhabitants.

7.4 Alternatives

Since the dam is not presently used by the Owner, an alternative to the above recommendations and remedial measures is to remove the dam and eliminate the storage behind it, so that there is no dam failure risk. Removing the dam would require engineering studies to assess the upstream and downstream impact of such an action.

APPENDIX A - INSPECTION CHECK LIST

	<u>Page</u>
<u>VISUAL INSPECTION PARTY ORGANIZATION</u>	A-1
<u>VISUAL INSPECTION CHECK LIST</u>	
Outlet Works - Spillway Weir, Approach and Discharge Channels	A-2
Low-level Outlet Works - Service Bridge Gate Control Mechanism and Outlet Gate	A-3
Conduit Outlet Works - Intake Structure	A-4

VISUAL INSPECTION PARTY ORGANIZATION

NATIONAL DAM INSPECTION PROGRAM

Dam: Pleasant Street

Date: 8 March 1979

Time: 1500 - 1615

Weather: Cloudy, 40's

Water Surface Elevation Upstream: Approximately El. 74.7 NGVD
(2.5 ft. above top of spillway weir)

Stream Flow: Heavy (approx. 2,000 cfs)

Inspection Party:

Peter L. LeCount
Richard A. Brown
Haley & Aldrich, Inc.

- Soils/Geology

A. Ulvi Gulbey

- Hydraulic/Hydrologic

Robert P. Howard

- Structural/Mechanical

William Kane

Camp, Dresser & McKee, Inc.

Present During Inspection:

Jerry Gagney, Maintenance

Beauty Box, Inc. (Tenant of Goldcoff Realty)

David Fisher, Head of Maintenance (present part-time)

Goldcoff Realty, Inc.

VISUAL INSPECTION CHECK LIST NATIONAL DAM INSPECTION PROGRAM

DAM: Pleasant Street Dam

DATE 8 Mar. 79

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - SPILLWAY</u> <u>WEIR, APPROACH AND</u> <u>DISCHARGE CHANNELS</u></p> <p>a. <u>Approach Channel</u></p> <p>General Condition</p> <p>Loose Rock Overhanging Channel</p> <p>Trees Overhanging Channel</p> <p>Floor of Approach Channel</p> <p>b. <u>Weir and Training Walls</u></p> <p>General Condition</p> <p>Rust or Staining</p> <p>Spalling</p> <p>Any Visible Reinforcing</p> <p>Any Seepage or Efflorescence</p> <p>Drain Holes</p> <p>c. <u>Discharge Channel</u></p> <p>General Condition</p> <p>Loose Rock Overhanging Channel</p> <p>Trees Overhanging Channel</p> <p>Floor of Channel</p> <p>Other Obstructions</p>	<p>Condition good. Approach channel walls consist of existing building foundations</p> <p>None observed</p> <p>None observed</p> <p>None observed</p> <p>View of spillway weir obscured by flowing water. No signs of movement noted. Training walls are the foundation walls of existing buildings in good condition</p> <p>None observed - sheet flow over weir</p> <p>Not applicable</p> <p>Not applicable</p> <p>None observed</p> <p>None observed</p> <p>Split flow channels perpendicular to dam in good condition. Cross channel adjacent to dam about 15' in good condition</p> <p>None observed</p> <p>Small tree overhanging left channel</p> <p>Not observed, submerged</p> <p>None observed</p>

FILE NO. 4160

HALEY & ALDRICH, INC.
CAMBRIDGE, MASSACHUSETTS

A-2

VISUAL INSPECTION CHECK LIST NATIONAL DAM INSPECTION PROGRAM

DAM: Pleasant Street Dam DATE: 8 Mar. 79

AREA EVALUATED	CONDITION
<p><u>LOW-LEVEL OUTLET WORKS - SERVICE BRIDGE, GATE CONTROL AND OUTLET GATE</u></p> <p>a. <u>Service Bridge</u></p> <p>Longitudinal Members</p> <p>Transverse Members</p> <p>Deck</p> <p>Railings</p> <p>Paint</p> <p>b. <u>Gate Control Mechanism</u></p> <p>General Condition</p> <p>c. <u>Outlet Gate</u></p> <p>General Condition</p> <p>Unusual Seepage or Leaks in Gate Chamber</p>	<p>Steel channels are rusted but in good condition</p> <p>Steel channels are rusted but in good condition</p> <p>Wood decking in good condition</p> <p>Steel angle railing on upstream side. Rusted but in good condition</p> <p>None observed</p> <p>Wooden platform for a reported 4 ft. square gate utilizing a rack and pinion device with a worm gear wheel. The gate mechanism in good condition while the platform can only be considered fair. Some of the platform boards loosened up. Operator indicates this to be a common problem. Platform supports are reported to be wood, but not observed. No handrails observed around platform</p> <p>Reported 4 ft. square gate at bottom of dam some 23 ft. to the left of the right intake. Gate not observed due to flow over weir</p> <p>Not observed, obscured from view by sheet flow over weir</p>

FILE NO. 4160

**VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM**

DAM: Pleasant Street Dam DATE: 8 Mar. 79

AREA EVALUATED	CONDITION
<u>CONDUIT OUTLET WORKS - INTAKE STRUCTURE</u> a. <u>Concrete and Structural</u> General Condition Gates Stoplogs Hand Rail	 Concrete intake submerged within 3 in. of top of slab. Three uncovered intake openings on upstream side. Opening behind the right intake opening covered with grating in fair condition. A large opening on the downstream side covered with wood in good to fair condition. A 1945 date inscribed in concrete slab None observed Appears to be stoplogs in place at the three intakes, but were submerged None observed

APPENDIX B - ENGINEERING DATA

	<u>Page</u>
<u>LIST OF AVAILABLE DATA</u>	B-1

PRIOR INSPECTION REPORTS

<u>Date</u>	<u>Description</u>	
6 November 1974	Mass. Dept. of Environmental Quality Engineering	B-2

DRAWINGS

None available

OTHER INFORMATION

Plan of area immediately downstream of dam, based on 1973 aerial photo, Camp, Dresser & McKee, Inc., October 1976	B-8
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LIST OF AVAILABLE DATA
PLEASANT STREET DAM

<u>Document</u>	<u>Contents</u>	<u>Location</u>
State inspection report, Dracut Dam No. 4-9-79-2	One report on file, dated 6 November 1974, includes description of dam.	Mass. Department of Environ- mental Quality Engineering, Division of Waterways, 100 Nashua Street, Boston, MA 02114 and page B-2
Town of Dracut, Massachusetts, Sewage Works Improvements, Pleasant Street, Camp, Dresser & McKee, Inc., October 1976	Plan of area immediately downstream of dam. (Included only for general interest)	Camp, Dresser & McKee, Inc., One Center Plaza, Boston, MA 02108 and page B-8

INSPECTION REPORT - DAMS AND RESERVOIRS

of file 220

(1) Location: City/Town DRACHT

Dam No. 4-9-79-2

Name of Dam BEAVER BROOK DAM
(Pleasant Street)

Inspected by: C. Johns & J. Murphy

Date of Inspection 11/6/74

(2) Owners: per: Assessors _____ Prev. Inspection _____

Reg. of Deeds _____ Pers. Contact _____

1. J. P. Stevens Co., Inc. (Babco Asso.) Pleasant St. Dracht, N.H.
Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

2. _____
Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. 957-1400

3. _____
Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

(3) Caretaker: (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

J. Orsato, 976 Merrimack Ave, Dracht, N.H. 01826 452-1011
Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

(4) No. of Pictures taken _____

(5) Degree of Hazard: (if dam should fail completely)*

1. Minor ✓ 2. Moderate _____

3. Severe _____ 4. Disastrous _____

* This rating may change as land use changes (future development)

(6) Outlet Control: Automatic _____ Manual ✓

Operative ? _____ yes _____ No _____

Comments Unable to determine condition of gate because of its location near face of dam.

(7) Upstream Face of Dam:

Condition

1. Good ✓ 2. Minor repairs _____

3. Major repairs _____

Comments _____

DAM NO. 4-9-79-2

(8) Downstream Face of Dam. Condition 1 Good ☒ 2. Minor Repairs _____
3. Major Repairs _____ 4. Urgent Rep _____

Comments: _____

(9) Emergency Spillway: Condition 1 Good ☒ 2. Minor Repairs _____
3. Major Repairs _____ 4. Urgent Repairs _____

Comments: None

(10) Water Level @ time of inspection 9.5 ft. above ☒ below _____
top of ☒ Principal Spillway _____
Other: _____

(11) Summary of Deficiencies Noted:

Growth (Trees and Brush) _____

Animal Burrows and Washouts _____

Damage to slopes or toe of _____

Cracked or damaged masonry _____

Evidence of Seepage _____

Evidence of Piping _____

Erosion _____

Leaks _____

Trash and/or debris _____

Clogged or blocked _____

Other _____

(12) Remarks & Recommendations: (Fully Explain)

Appears to be Adequate.

(13) Overall Condition:

1. Safe ✓
2. Minor repairs needed _____
3. Conditionally safe - major repairs needed _____
4. Unsafe _____
5. Reservoir impoundment no longer exists (explain)
Recommend removal from inspection list _____

DESCRIPTION OF DAM
DISTRICT 4

Submitted by C. Johns & V. Murphy

Date 11/6/74

Dam No. 4-9-79-2

City/Town DRACUT

Name of Dam BEAVER BROOK
(~~at Pleasant St.~~)
(Pleasant St.)

1. Location: Topo Sheet No. 25B
Provide 8 1/2" x 11" in clear copy of topo map with location of dam clearly indicated.

2. Year-built: Unknown Year/s of subsequent repairs ✓

3. Purpose of dam: Water Supply ✓ Recreational ✓
Irrigation ✓ Other ✓

4. Drainage Area: 4 + Sq. mi. 2560 Acres.

5. Normal Ponding Area: 15 acres; Ave. Depth 5'±
Impoundment: 24 sec. gals. 75 acre ft

6. No. and type of dwellings located adjacent to pond or reservoir
i.e. summer homes etc. 1 Bill building

7. Dimensions of Dam: Length 97' Max Height 15'±
Slopes: Upstream face 2:1
Downstream face Vertical
Width across top 6'±

8. Classifications of Dam by Materials:
Earth ✓ Conc. Masonry ✓ Stone Masonry ✓
Timber ✓ Rockfill ✓ Other ✓

9. A. Description of present land usage downstream of dam: 80% rural
20% forest

B. Is there a storage area of flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure:
no ✓ yes ✓ MARRIMAC RIVER

DAM NO. 4-9-79-2

10. Risk to life and property in event of complete failure.

No. of people

No. of homes

No. of businesses

No. of industries

No. of utilities

Railroads

Other dams

Other

none

Type

Type

11. Attach sketch of dam to this form showing section and plan. 8 1/2" x 11" sheet

DAM No. 4-9-79-2

BLDG.

FLOOD

GRANITE

97 ±

A-A

Stone Masonry & Earth Fill

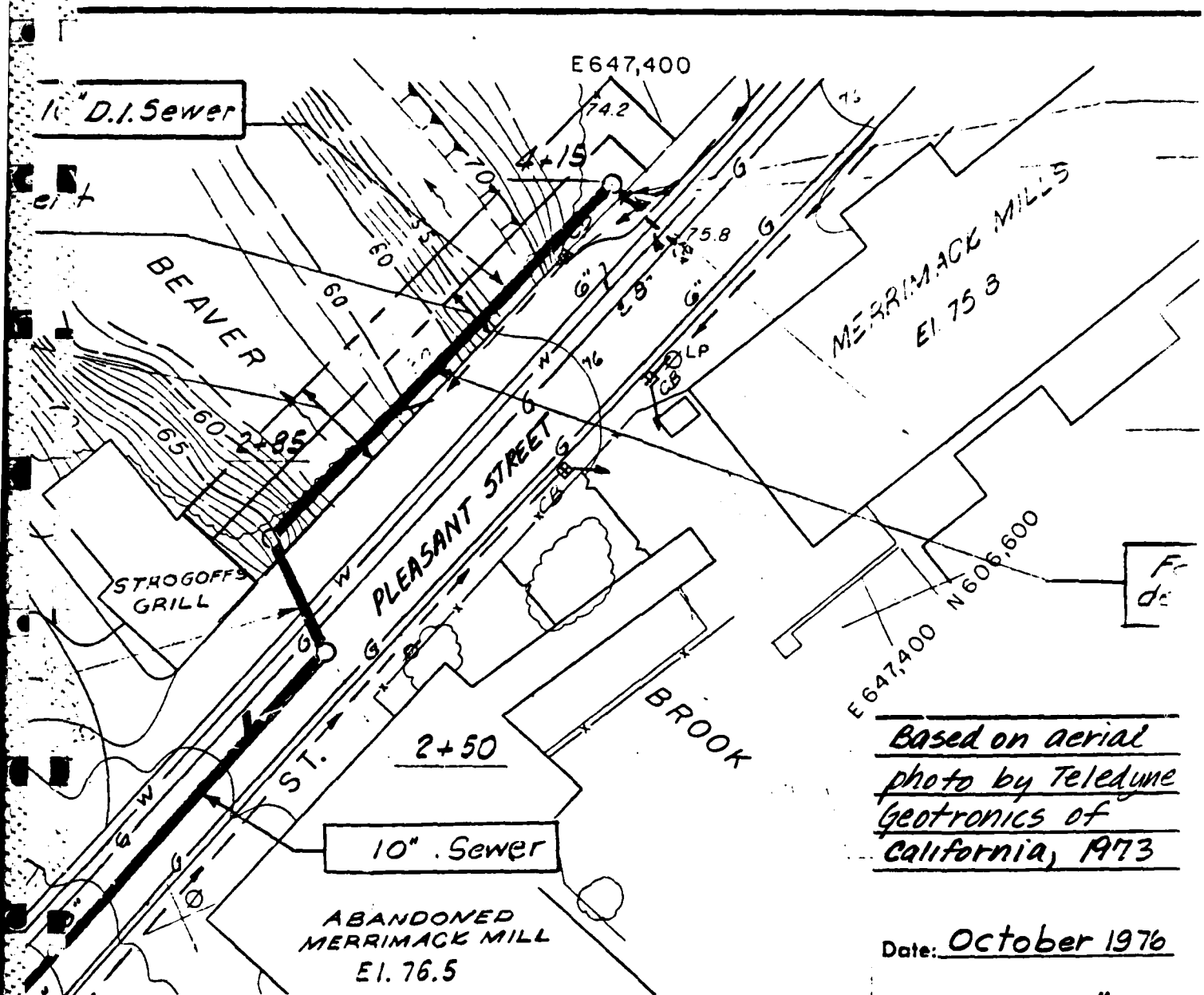
29°

95 ±

29°

PLEASANT AVE.

B-7



Based on aerial
photo by Teledyne
Geotronics of
California, 1973

Date: October 1976

Scale: Approx. 1" = 40'

TOWN OF DRACUT, MASSACHUSETTS
SEWAGE WORKS IMPROVEMENTS

SEWERS - CONTRACT NO. 1
 BEAVER BROOK INTERCEPTOR
 LAKEVIEW AVE. - STA. 0+00 TO STA. 15+05
 PLEASANT ST. - STA. 0+00 TO STA. 4+15



CAMP DRESSER & McKEE Inc.
 Consulting Engineers
 Boston, Mass.

SHEET NO.

2

558-23820

B-8

APPENDIX C - PHOTOGRAPHS

LOCATION PLAN

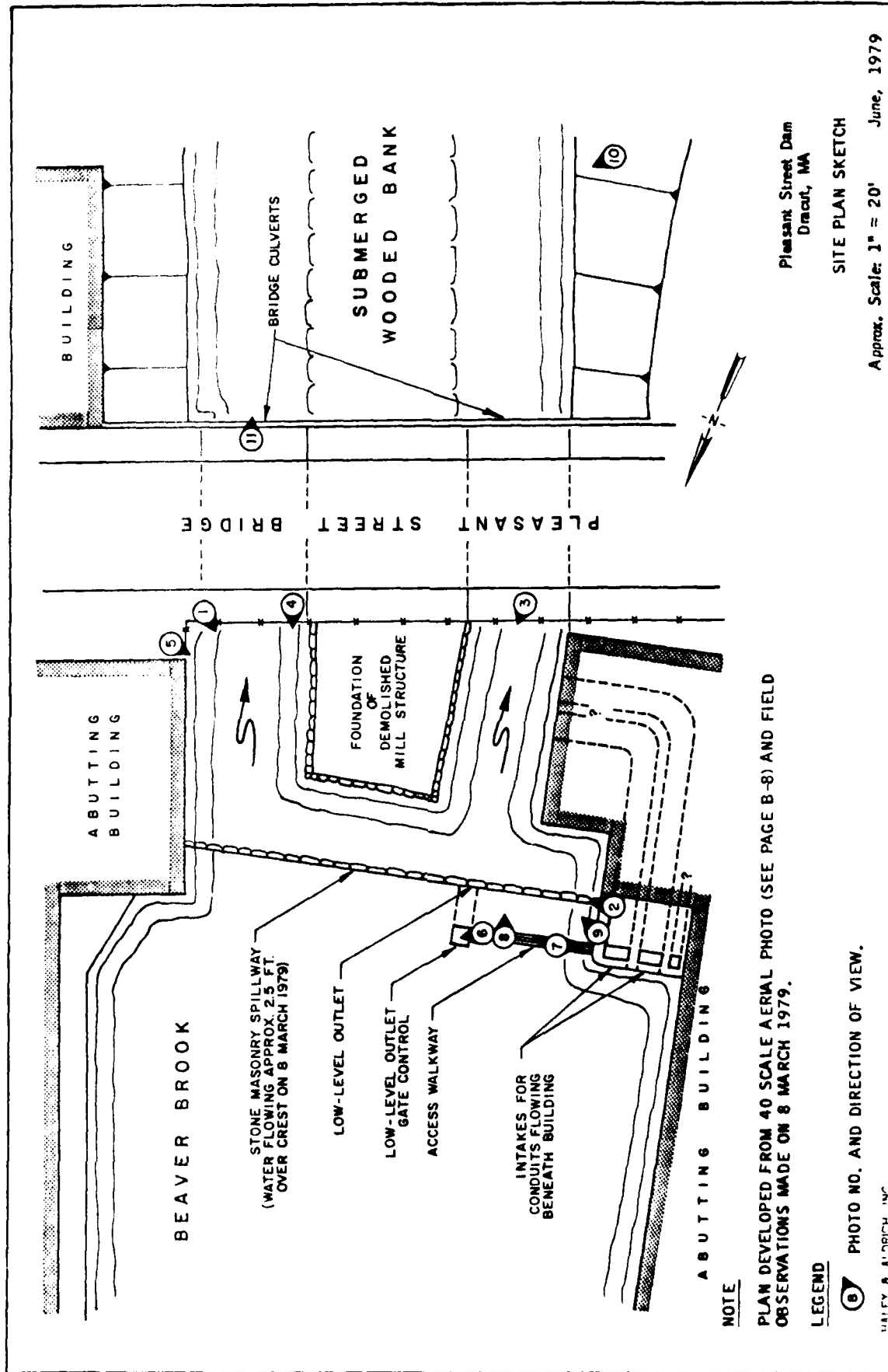
Site Plan Sketch

Page

C-1

PHOTOGRAPHS

<u>No.</u>	<u>Title</u>	<u>Roll</u>	<u>Frame</u>	<u>Page</u>
1.	Overview of Pleasant Street Dam	C33	31	vi
2.	View along axis of spillway	11	18	C-2
3.	Stone masonry spillway visible during period of low flow (November 1978)	C31	1	C-2
4.	Spillway and left abutting building	C33	30	C-3
5.	Spillway and right abutting building	11	23	C-3
6.	Low-level outlet gate control mechanism	C33	21	C-4
7.	Concrete intake structure at right abutment of dam	C33	24	C-4
8.	Right culvert under Pleasant Street	C33	22	C-5
9.	Left culvert under Pleasant Street and remnants of a building foundation between dam and Pleasant Street	C33	23	C-5
10.	Downstream face of Pleasant Street Bridge	C33	34	C-6
11.	Beaver Brook downstream of Pleasant Street	C33	35	C-6



Pleasant Street Dam
Dracut, MA

SITE PLAN SKETCH

Approx. Scale: 1" = 20'

June, 1979

NOTE

PLAN DEVELOPED FROM 40 SCALE AERIAL PHOTO (SEE PAGE B-8) AND FIELD OBSERVATIONS MADE ON 8 MARCH 1979.

LEGEND

8 PHOTO NO. AND DIRECTION OF VIEW.

WATF & BORDEN INC.



2. View along axis
of spillway



3. Stone masonry spillway visible during period
of low flow (November 1978)



4. Spillway and left abutting building



5. Spillway and right abutting building



6. Low-level outlet gate control mechanism



7. Concrete intake structure at right abutment
of dam



8. Right culvert under Pleasant Street



9. Left culvert under Pleasant Street and remnants of a building foundation between dam and Pleasant Street



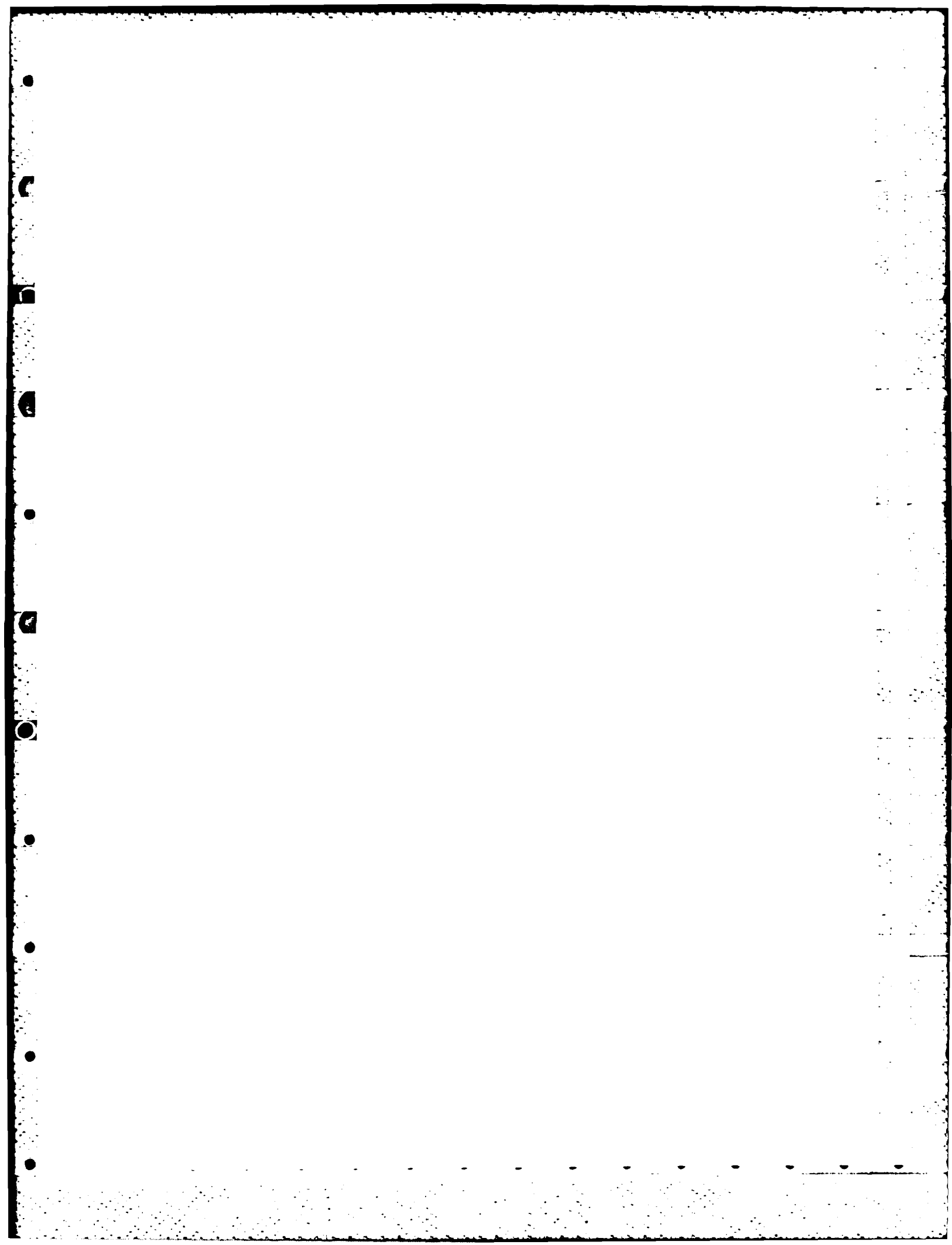
10. Downstream face of Pleasant Street Bridge

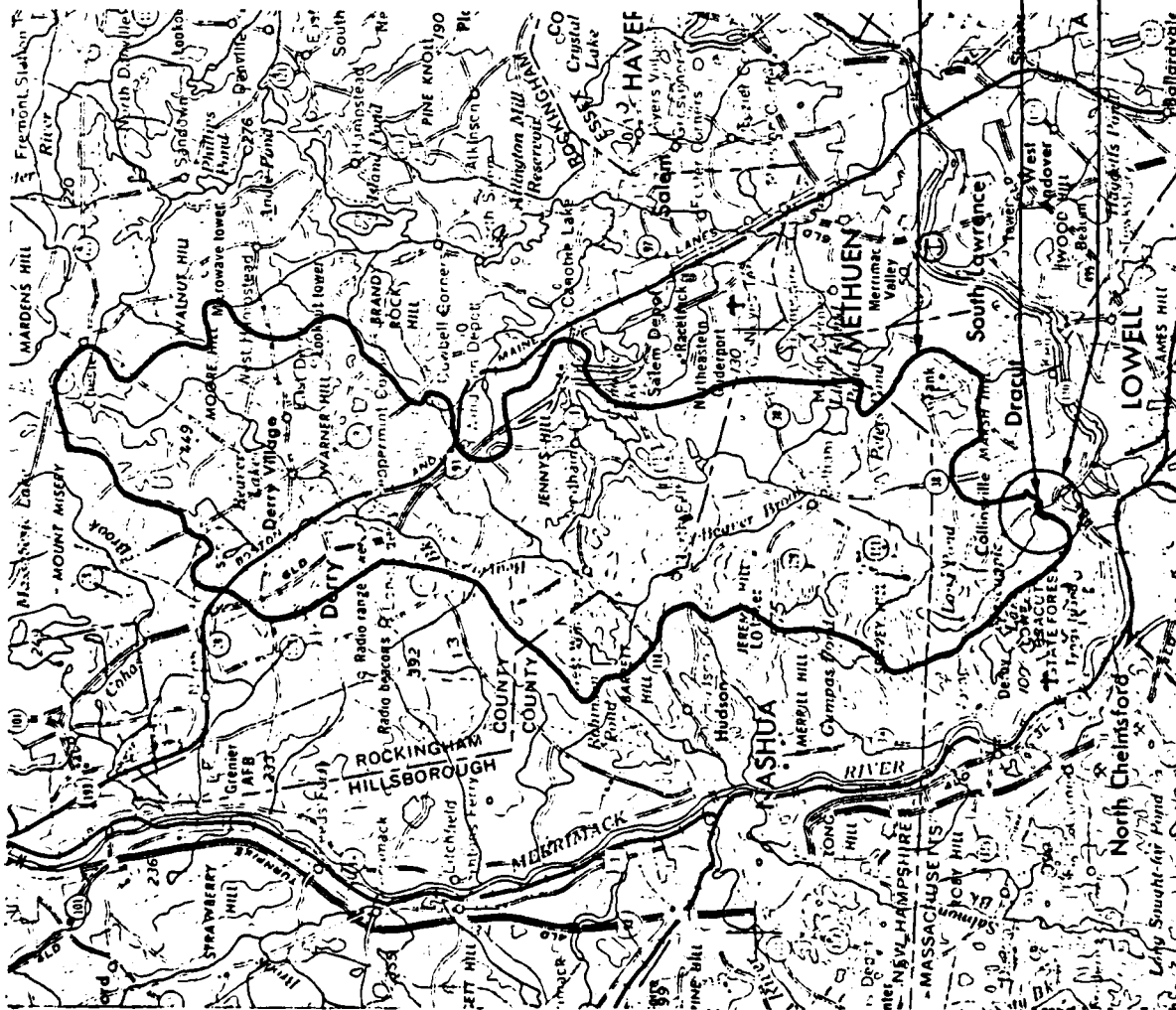


11. Beaver Brook downstream of Pleasant Street

APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS

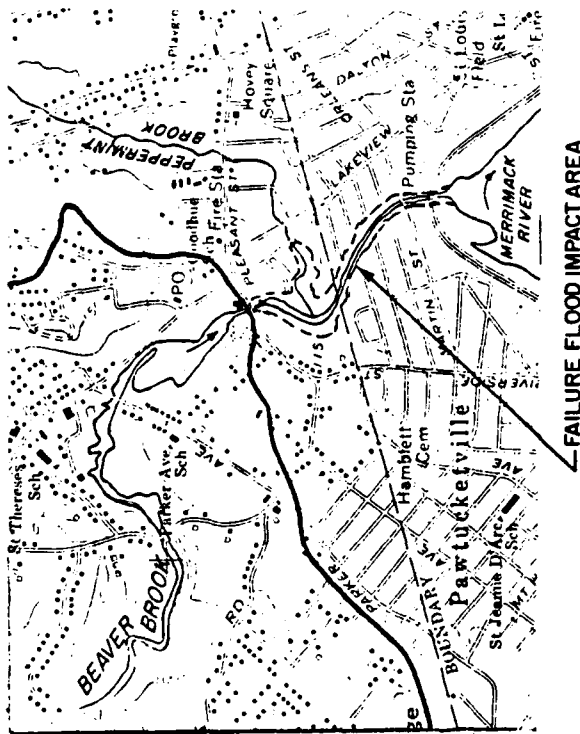
<u>Subject</u>	<u>Page</u>
Drainage Area and Failure Flood Impact Area Map	D-1
Size Classification, Hazard Potential and Test Flood Development	D-2
Surcharge Storage Routing	D-3
Stage-Discharge Curve at Dam Site	D-4
Pond Area-Volume Curve	D-5
Tail Water: Stage-Discharge Curve	D-6
Dam Failure Analysis	D-7
Failure Flood Profile	D-9
Downstream Channel Configurations and Stage- Discharge Curves	D-10





CAMP DRESSER & MCKEE Inc.
Consulting Engineers
Boston, Mass.

D-1



INSERT

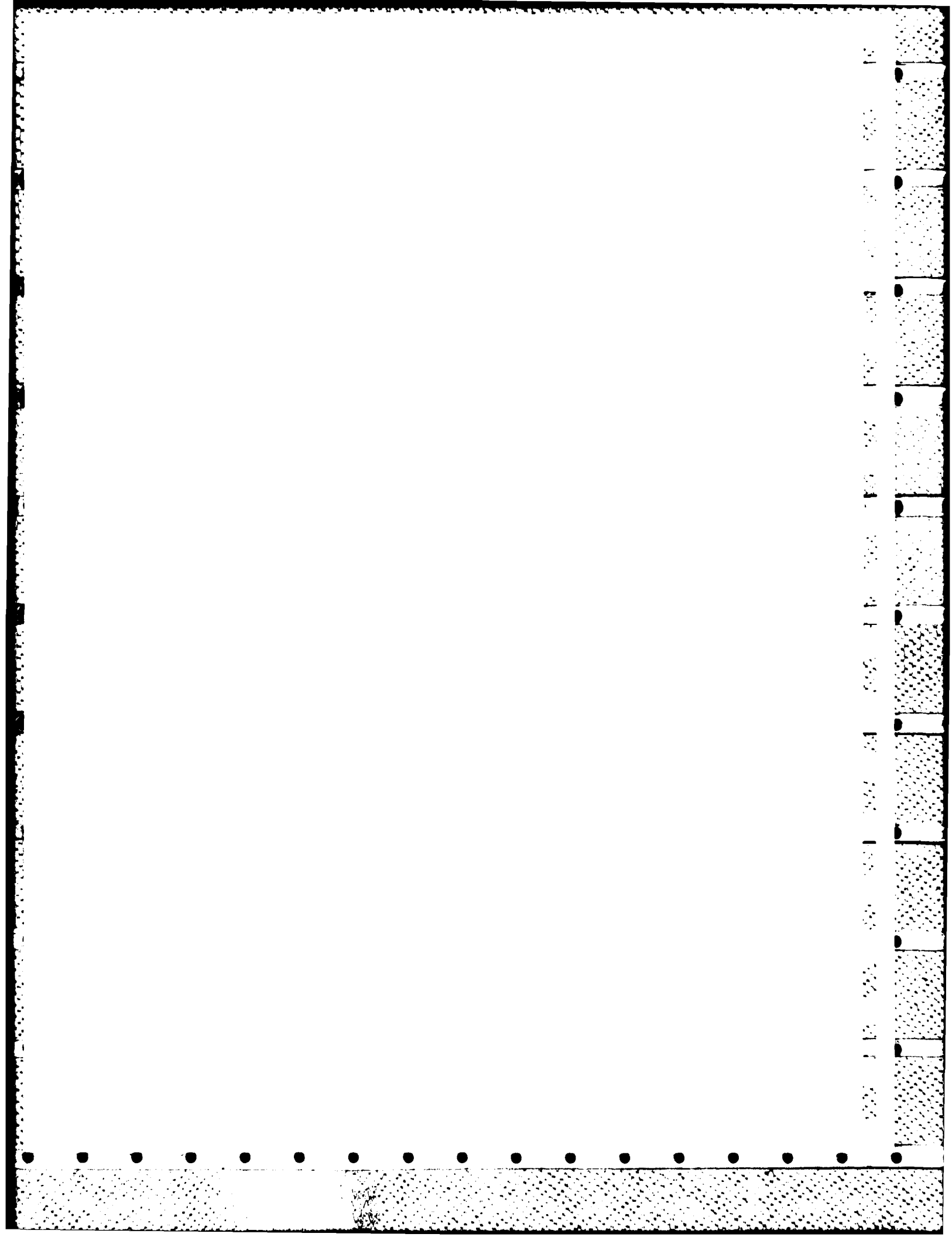
DRAINAGE AREA BOUNDARY

DAM

SEE INSERT FOR FLOOD IMPACT AREA



PLEASANT STREET DAM
DRAINAGE AREA MAP
SCALE: 1:250,000



Size Classification

Dam Height : Ele. 76' - Ele. 57.2' = 18.8' < 40'

Storage Volume : 140 acre-feet
(@ Ele. 76.0) < 1000 acre-feet

Therefore, dam is classified "SMALL"

Hazard Potential Classification

In the event of a dam failure, an asphalt plant with its office building and machinery parking lot has a chance of being flooded depending on the water surface elevation in the Merrimack River (WSE = 66.0 or higher)

The hazard potential is considered significant because of a potential for loss of a few lives and damage to residential and business property.

Last Flood Development

Size : Small
Hazard : Significant

Therefore, $Q_T = \frac{1}{4} \text{ to } \frac{1}{2} \text{ PMF}$
Use $\frac{1}{4} \text{ PMF}$

Watershed Drainage Area = 92.4 sq. mi. = 59,136 acres
Topography : 90% rolling ; 10% Flat land (lakes, ponds, swamps)

Peak Flow Rate = 949 cfs / sq. mi.
PMF Inflow = 87,700 cfs
Test Flood Inflow = 21,925 cfs

Surcharge Storage Routing

$Q_p = 21,925$; Max. runoff = 5.0 in.
WSE @ the pond behind dam = 93.0 ft. (See stage-discharge curve Page D-4)
Volume @ 93.0 ft. = 2,000 acre-ft. (See area-volume curve Page D-5)

Normal Pond Volume @ 72.2 ft. = 80 acre-ft.

$$STOR 1 = \frac{(2000-80)12}{59,136 \text{ cfs}} = 0.39 \text{ in.}$$

$$Q_{p2} = 21,925 \left(1 - \frac{0.39}{5}\right) = 20,215 \text{ cfs} \rightarrow \text{WSE} = 92.1 \text{ ft.}; \text{Vol.} = 1820 \text{ ac. ft.}$$

$$STOR 2 = \frac{(1820-80)12}{59,136} = 0.35 \text{ in.}$$

$$STOR_{av.} = 0.37 \text{ in.}$$

$$Q_{p3} = 21,925 \left(1 - \frac{0.37}{5}\right) = 20,305 \text{ cfs} \rightarrow \text{WSE} = 92.2 \text{ ft.}; \text{Vol.} = 1830 \text{ ac. ft.}$$

Test Flood Outflow = 20,300 cfs

Spillway Capacity

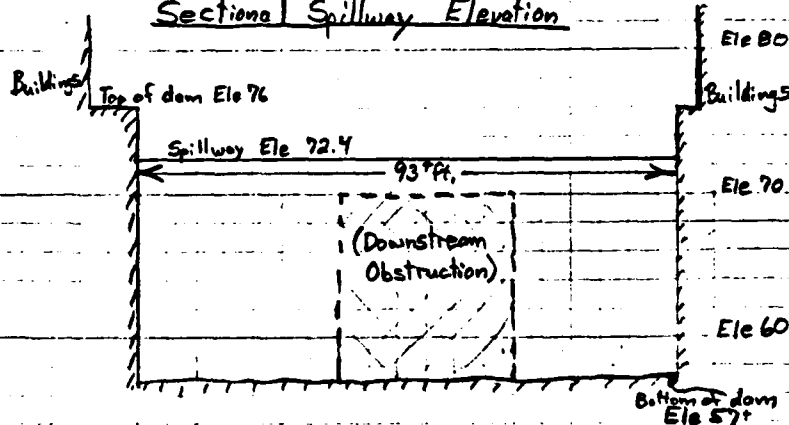
Capacity at top of dam $\approx 2,500$ cfs (See stage-discharge curve Page D-4)

WSE below dam = 82.2 ft. @ Test Flood Outflow of 20,300 cfs
(See stage-discharge curve Page D-6)

$$\text{WSE differential} = 92.2 - 82.2 = 10 \text{ ft.}$$

$$Q \text{ through spillway at WSE } 92.2 \text{ ft.} = 3.5 \times 93 \times 10^{1.5} = 10,300 \text{ cfs.}$$

Sectional Spillway Elevation



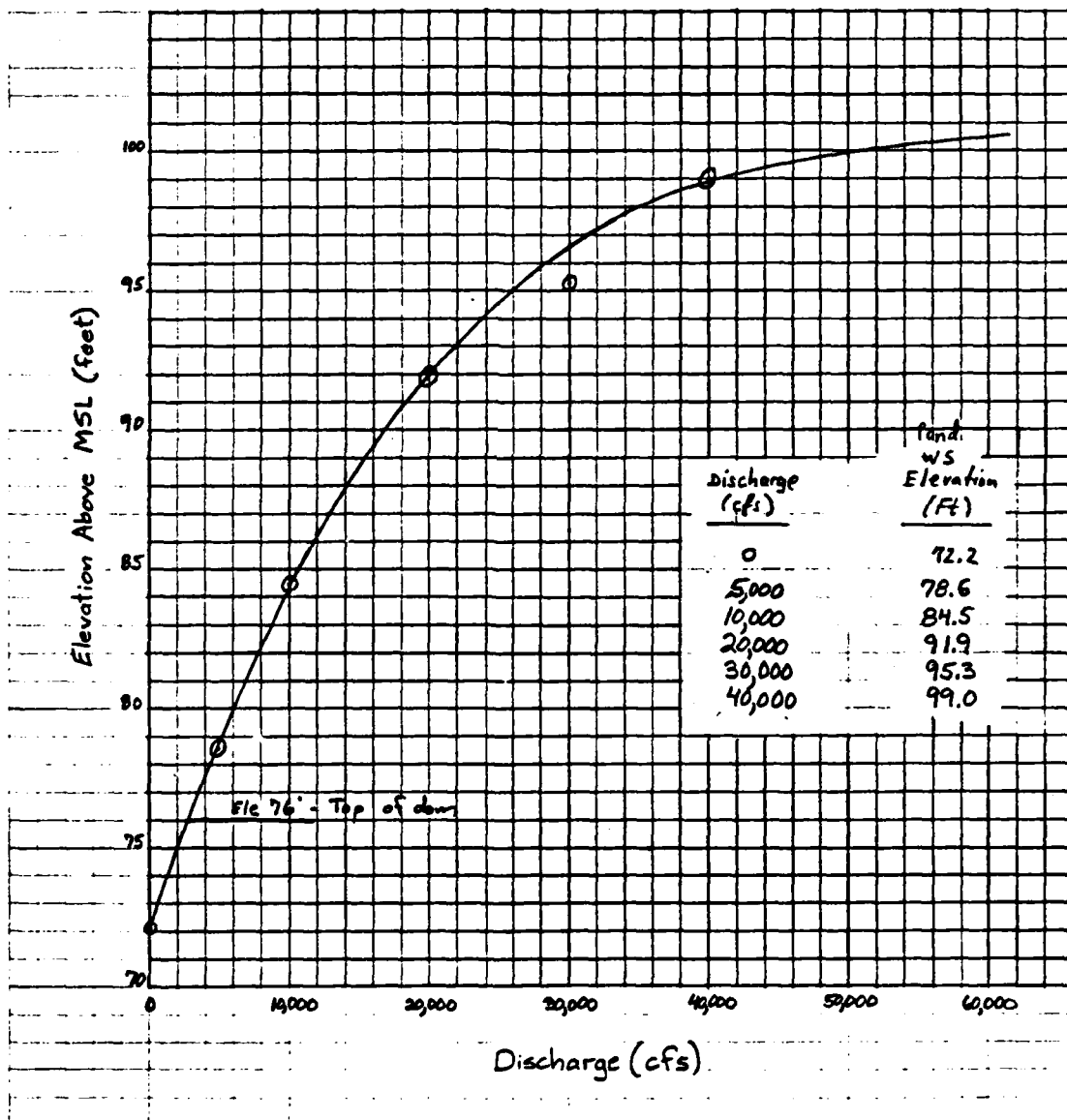
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DETAIL Pearson St. Dam - Drawn

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Stage-Discharge Curve at Dam Site

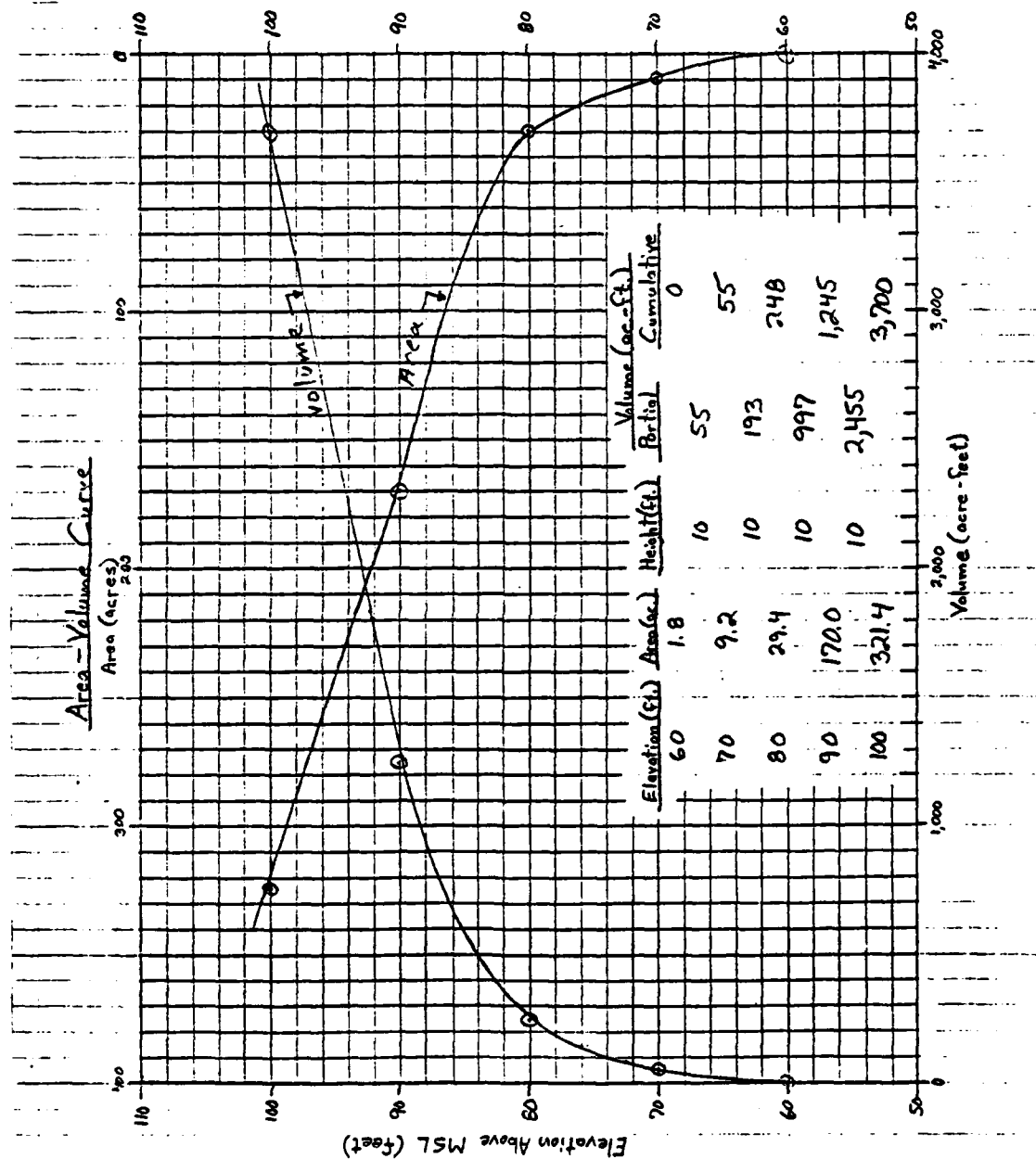


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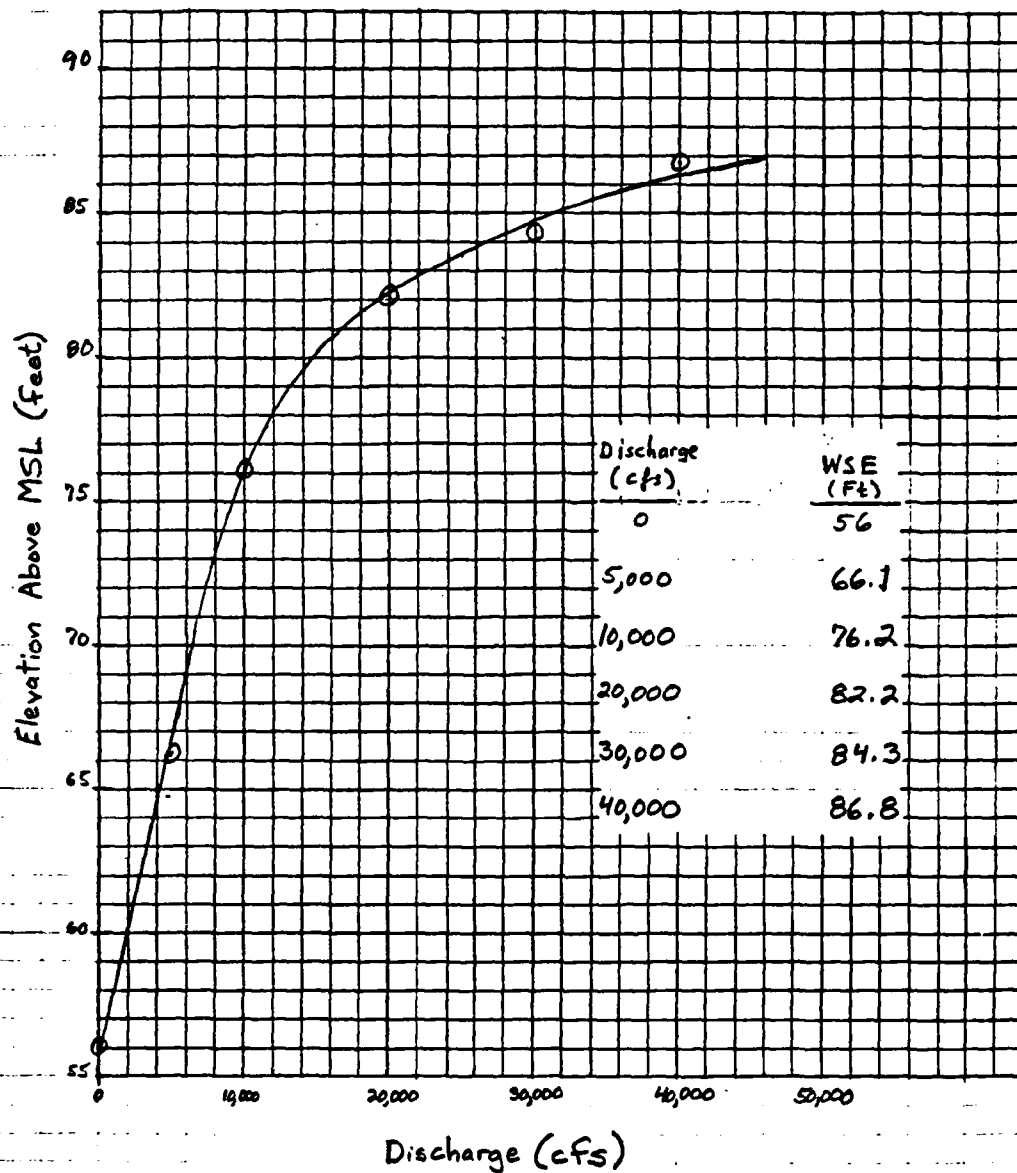
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Stage-Discharge Curve Upstream of Pleasant St. Bridge



Dam Failure Analysis

$$\text{Failure Flood Flow} \equiv Q_{p1} = \frac{8}{25} W_b \sqrt{g} Y^{1.5}$$

Length of mid-height of dam = 93 ft.
Assume 90% breach width (masonry dam)

$$W_b = 0.90 \times 93 = 83.7$$

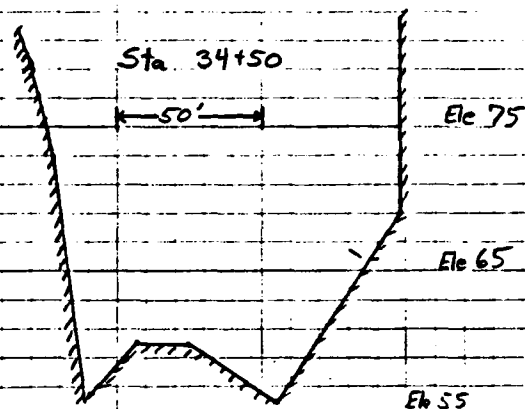
$$Y_b = 18.8 \text{ Ft.}; Y^{1.5} = 81.5$$

$$Q_{p1} = 11,470 \text{ cfs}$$

$$\text{Prior to Failure, Flow} = 2,400 \text{ cfs}$$

From dam tailwater to Peppermint Brook (Sta 34+50 to 29+00)

$$\text{WSE @ } 34+50 = 76.0' \quad \text{Area} = 2050 \text{ ft}^2$$



$$\text{WSE @ } 29+00 = 66.1' @ 11,470 \text{ cfs}$$

$$\text{Area @ } 11,470 \text{ cfs} = 1530 \text{ ft}^2$$

$$S = 140 \text{ ac-ft.}$$

$$V = 550 \times \left(\frac{2050 + 1530}{2} \right) = 23 \text{ ac-ft.}$$

$$\text{Trial } Q_{p2} = 11,470 \left(1 - \frac{23}{140} \right) = 9585 \text{ cfs}$$

$$\text{WSE @ } 29+00 = 65.0' \rightarrow A = 1250 \text{ ac-ft.}$$

$$V = 550 \times \left(\frac{2050 + 1250}{2} \right) = 21 \text{ ac-ft.}$$

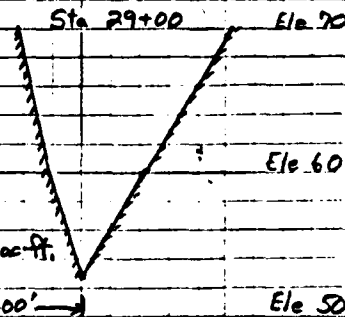
$$V_{ave} = 22 \text{ ac-ft.}$$

$$Q_{p3} = 11,470 \left(1 - \frac{22}{140} \right) = 9670 \text{ cfs}$$

$$\text{WSE} = 64.8' \rightarrow A = 1210 \text{ ac-ft.}$$

$$V = 21 \text{ ac-ft.} \approx V_{ave}$$

$$\text{@ Sta. } 29+00, Q = 9670 \text{ cfs} \quad \text{WSE} = 64.8'$$



Flood flow routing between confluence with Peppermint Brook (Sta 29+00) and Martin St. Bridge (Sta 10+50)

$$WSE @ Sta 29+00 = 68.5$$

$$WSE @ Sta 10+50 = 66.1$$

$$V_1 = 1850 \times \left(\frac{2170 + 2180}{2} \right) = 92 \text{ Ac. Ft.}$$

$$\text{Trial } Q_{p2} = 4440 \left(1 - \frac{92}{200} \right) = 2400 \text{ cfs}$$

$$\text{New } WSE @ Sta 10+50 = 66.1$$

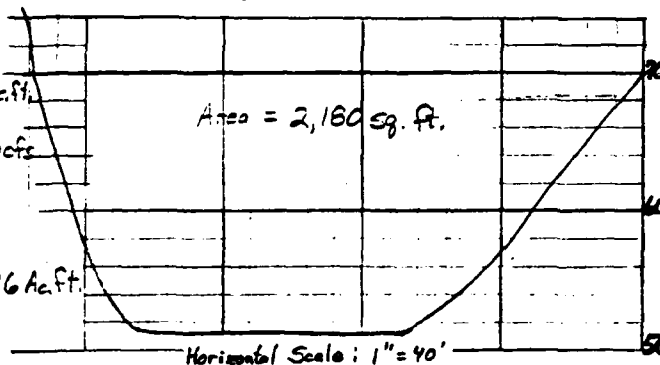
$$\text{New } WSE @ Sta 29+00 = 68.3$$

$$V_2 = 1850 \times \left(\frac{2180 + 2325}{2} \right) = 96 \text{ Ac. Ft.}$$

$$V_{ave} = 94 \text{ Ac. Ft.}$$

$$Q_{p2} = 4440 \left(1 - \frac{94}{200} \right) = 2350 \text{ cfs. @ Martin St. Bridge}$$

Section Sta 10+50



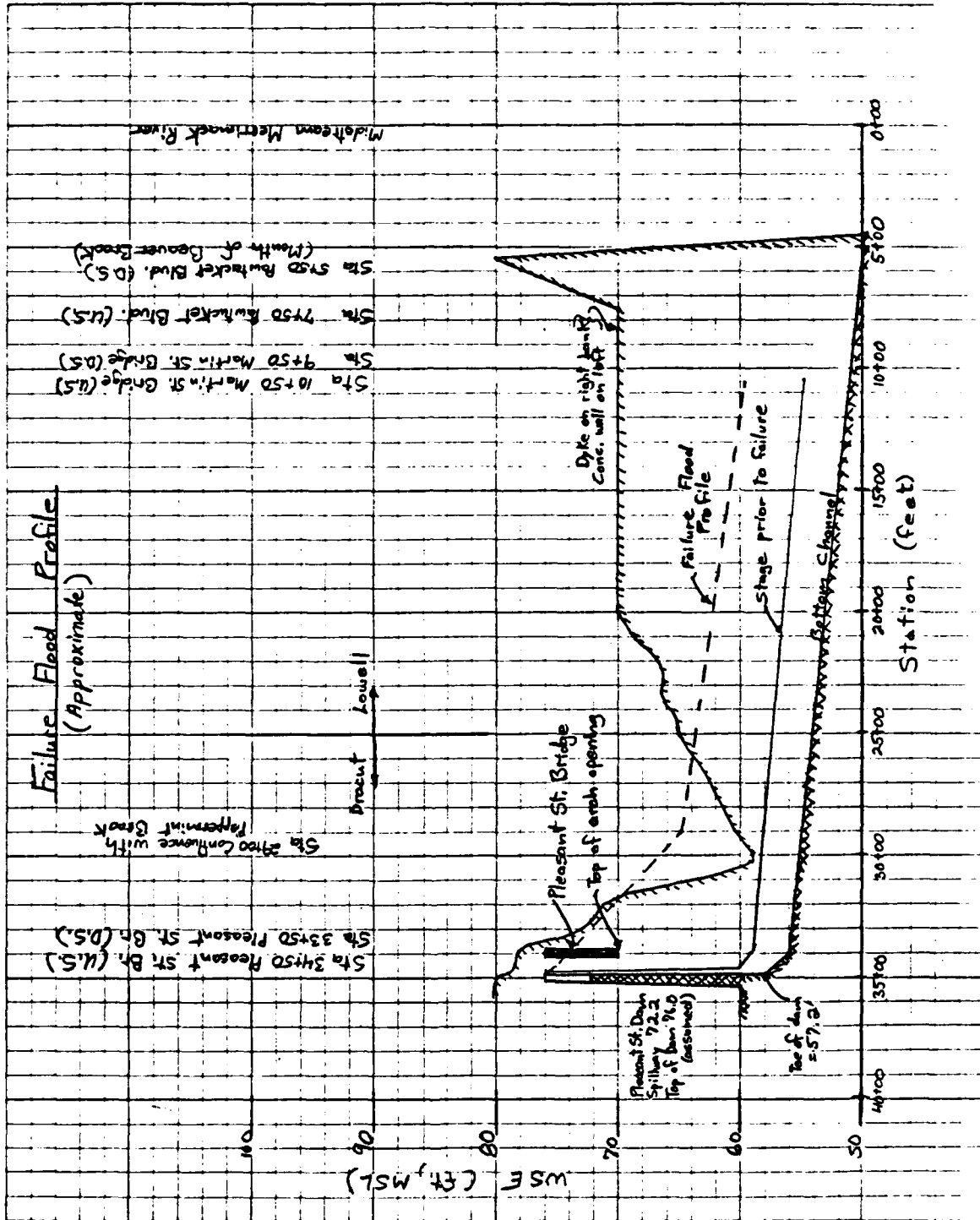
Note For the dam safety investigation, it is assumed that a failure would occur only at the dam which is under study and the other upstream and downstream facilities, such as dams and bridges, would remain intact; for example, we have not considered the effects on the dam under study which could be caused by failure of an upstream dam, especially a larger upstream dam.

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DOWNSTREAM CHANNEL
CONFIGURATIONS
AND
STAGE DISCHARGE CURVES

D-10

D-10

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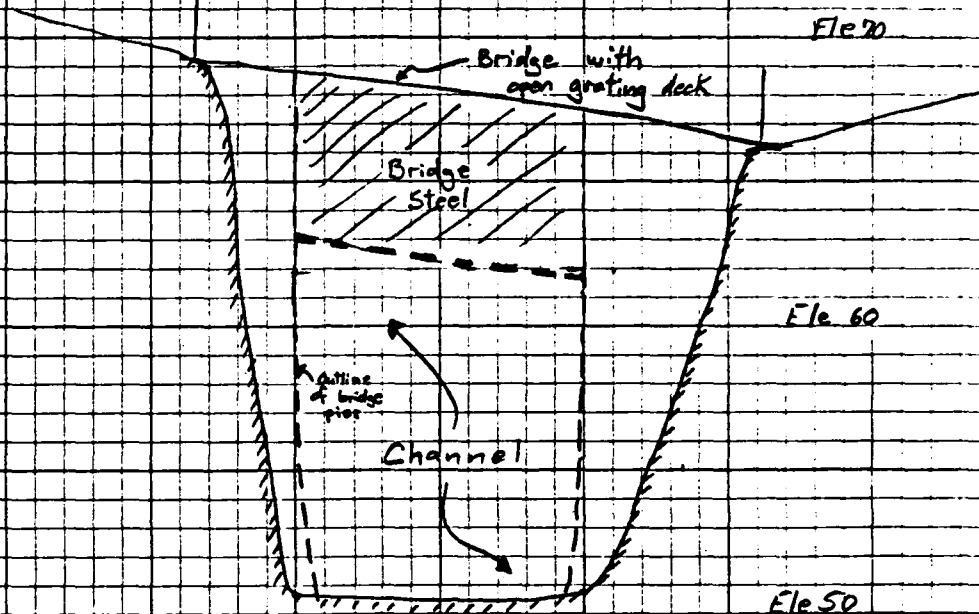
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Station 10+50
Gross - Section

Location: Martin Street Bridge
Scale: Horizontal 1"=50'
Vertical 1"=5'
View: looking upstream

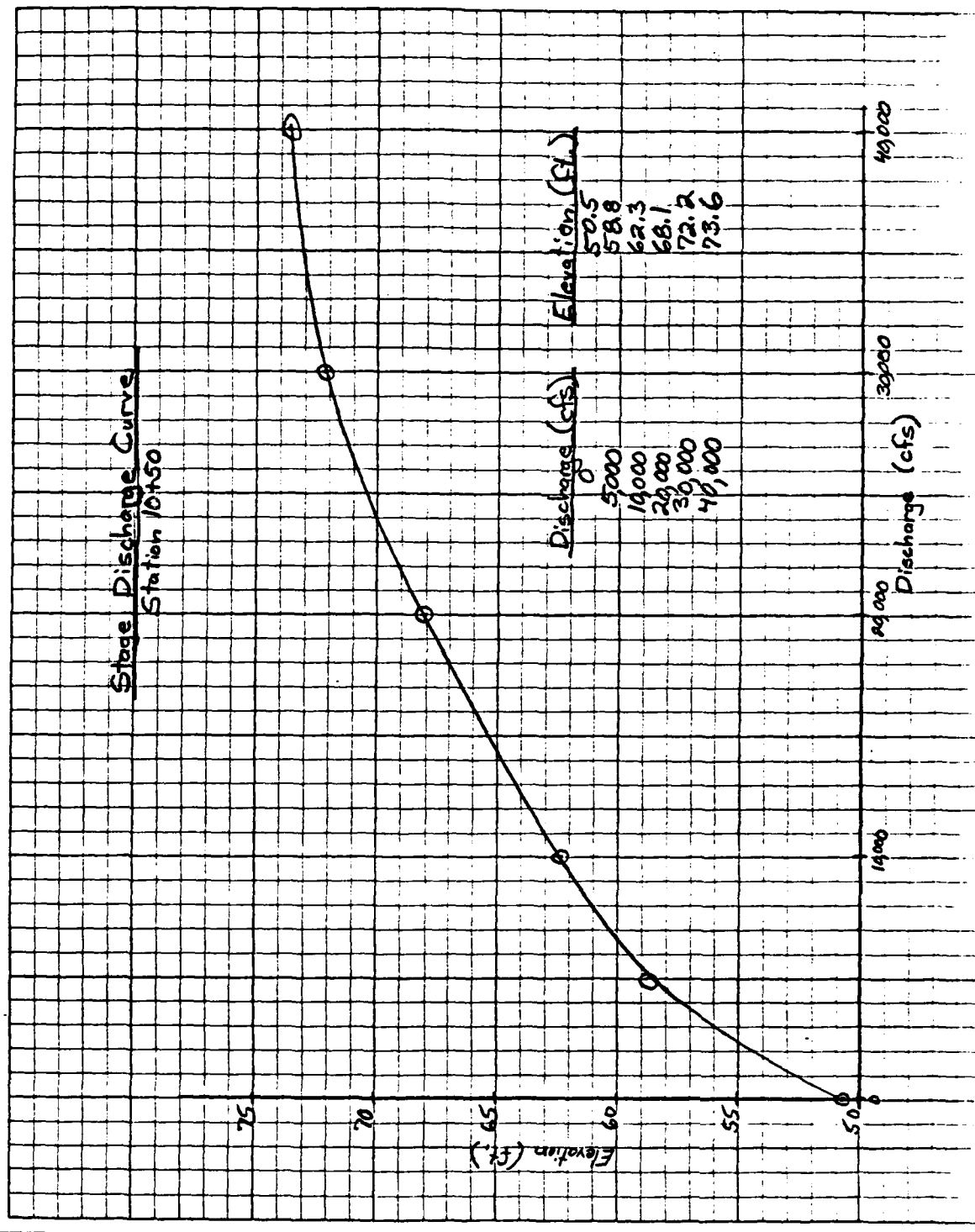


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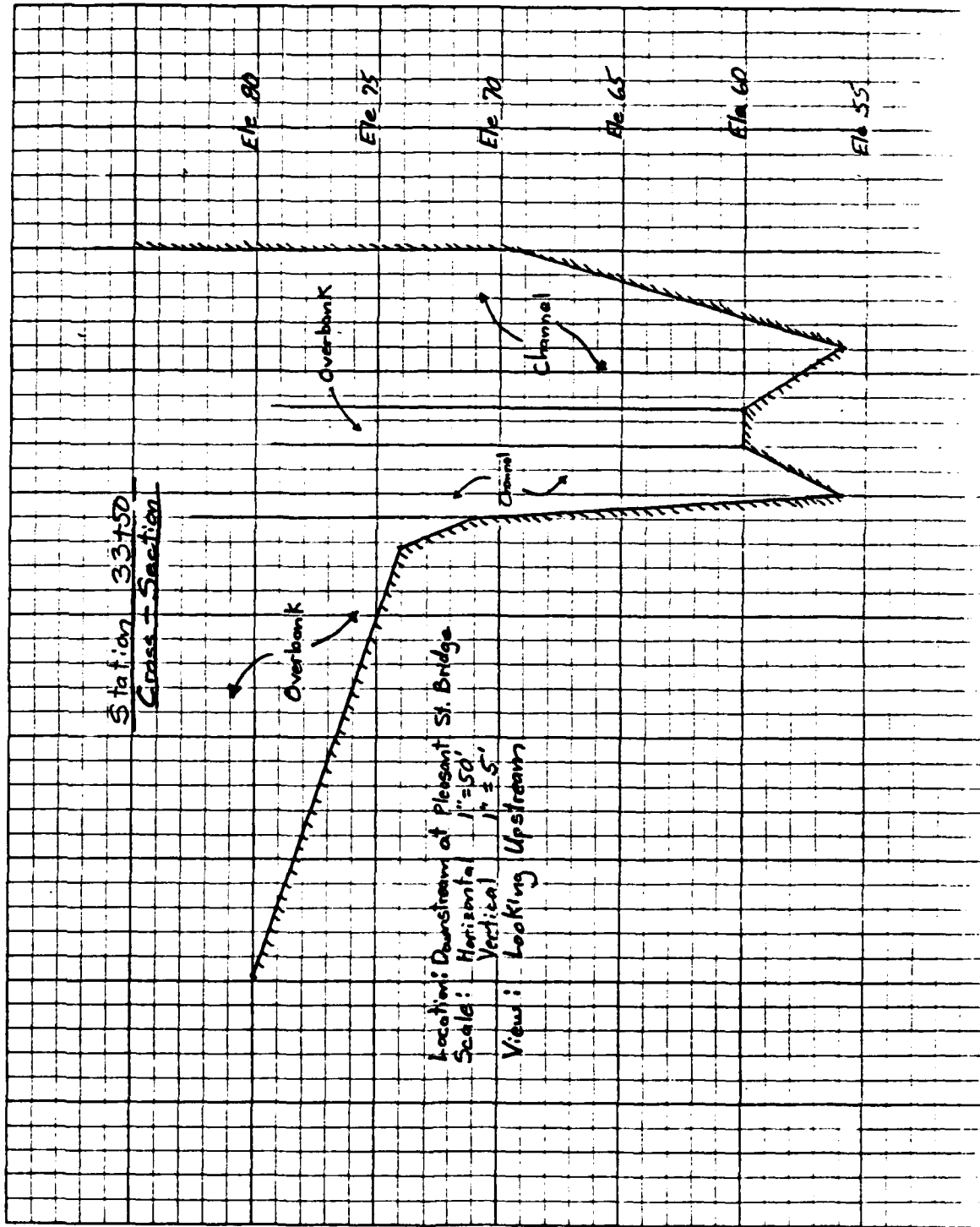


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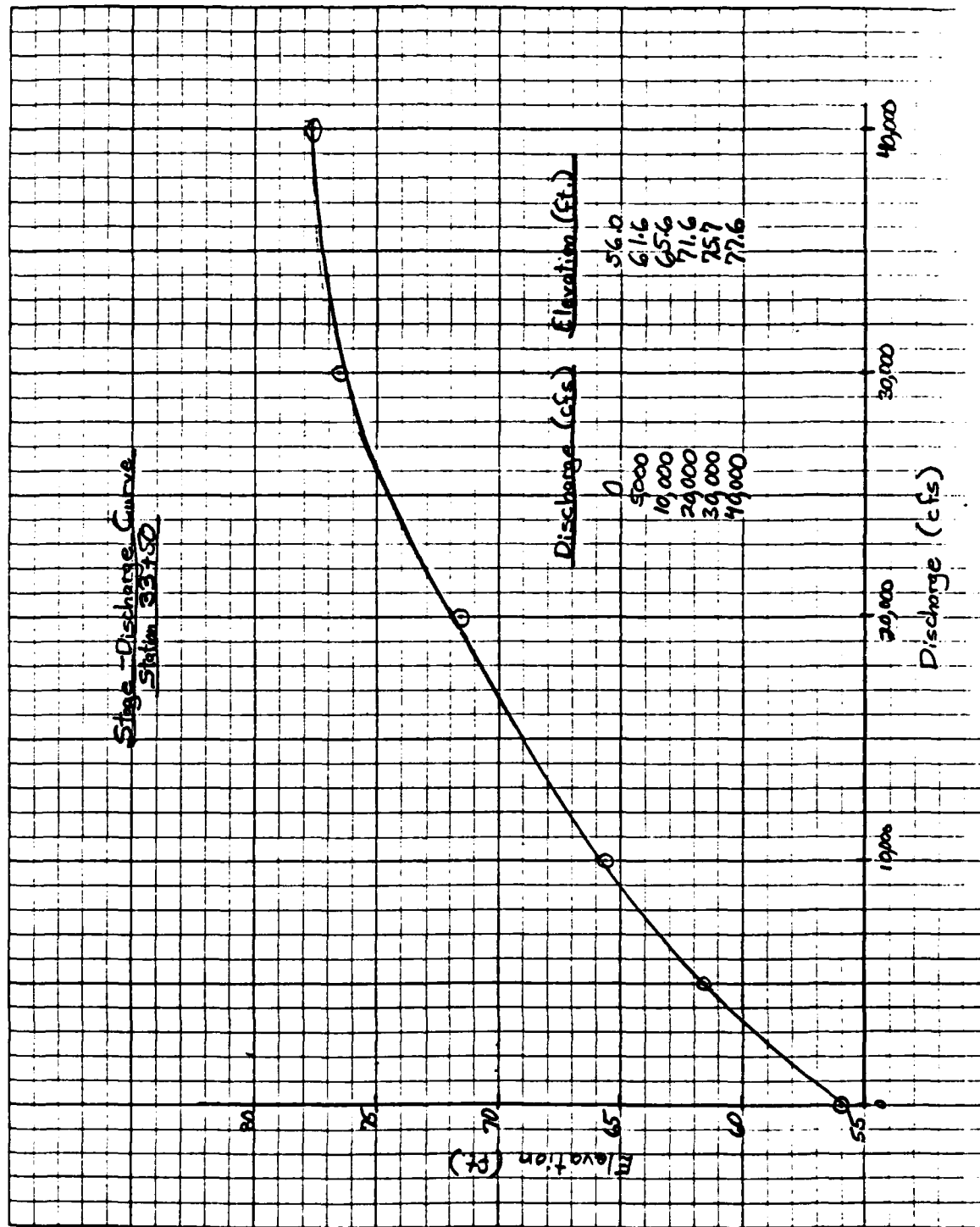


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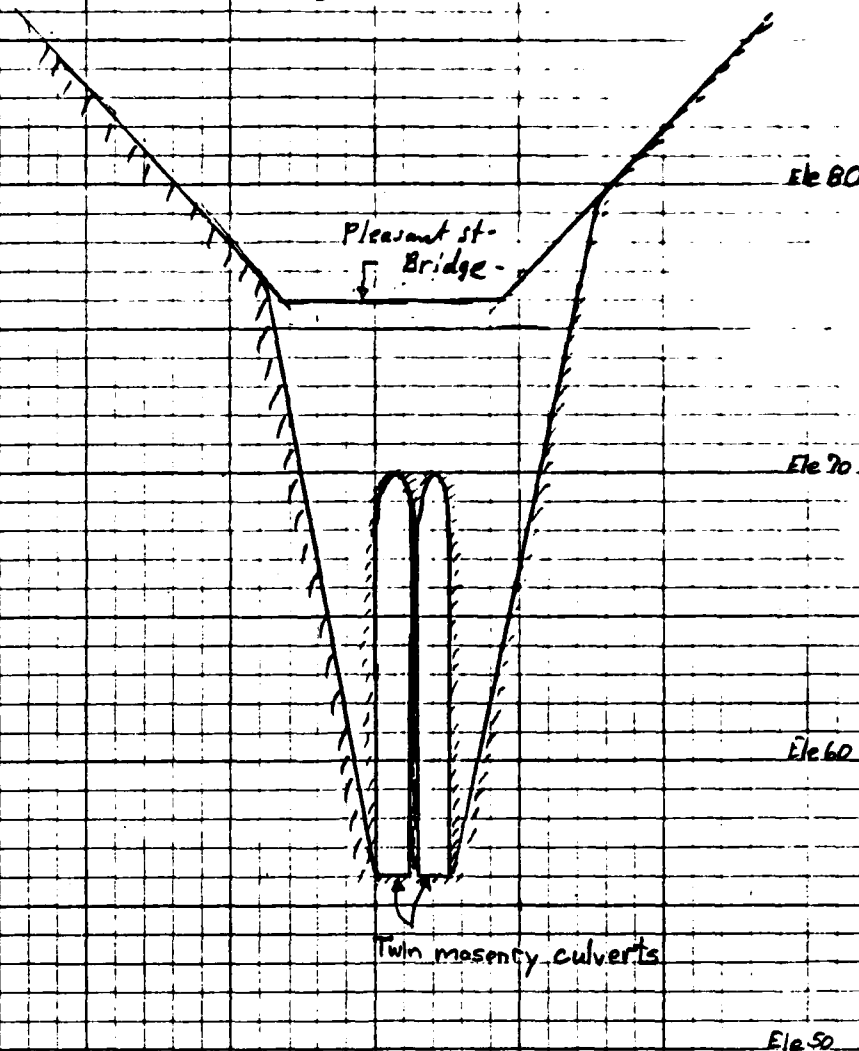
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DETAIL Pleasant St. Dam - Dremat

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Station 34+00

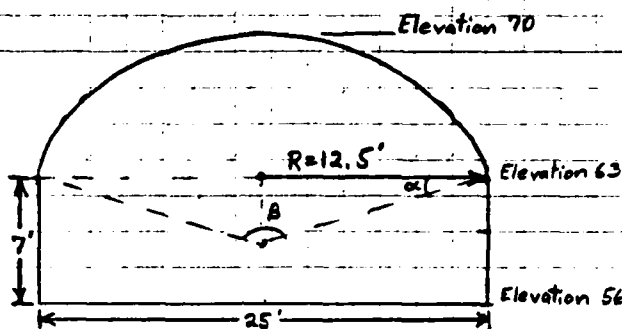
Location : Pleasant Street Bridge (Stage Discharge upstream is tailwater)
Scale : Horizontal 1" = 100'
Vertical 1" = 5'
View : Looking Upstream



Pleasant Street Bridge

Capacity of culverts beneath bridge deck when flowing full.

Assumed configuration, typical of both culverts:



Area of bottom rectangle = $7 \times 25 = 175$ sq. ft.

$$\angle \alpha = \arctan \frac{12.5-7}{12.5} = 24.5^\circ$$

$$\angle \beta = 180 - 2\alpha = 130^\circ$$

This represents $\frac{130}{360} = 0.36$ of the entire circle

Area encompassed by shaded portion = $\pi (12.5)^2 \times 0.36 = 179$ sq. ft.

"Triangular" area = $\frac{1}{2} \times 25 \times (12.5-7) = 69$ sq. ft.

Total area = $175 + (179 - 69) = 285$ sq. ft.

Wetted perimeter = $(0.36(\pi \times 25)) + 7 + 7 + 25 = 67$ ft.

Hydraulic radius = $\frac{285}{67} = 4.24$

$$Q_{cap.} = \frac{1.49}{n} A R^{2/3} S^{1/2} \times 2 \text{ conduits}$$

Use $S = 0.0070$; $n = 0.030$

$$Q_{cap.} = \underline{6205 \text{ cfs}}$$

Assumptions:

1. The head loss through the bridge can be determined using the orifice formula, after it is submerged.
2. The flow is equally divided between the two conduits beneath the bridge.

$$Q = CA\sqrt{2gh} \quad ; \quad c = 0.6$$

$$A = 285 \times 2 = 570 \text{ sq. ft.}$$

$$g = 32.2$$

$$Q = 2745\sqrt{h} \quad ; \quad h = (Q/2745)^2$$

5000 cfs

$$h = 3.3 \text{ ft.}$$

Midpoint of orifice = 63' (> Downstream elevation of 61.6')

Upstream elevation = 63 + 3.3 = 66.3' too low

Use Manning ($n=0.03$, $S=0.007$) $AR^{3/2}=1203$; WSE (trial & error) = 66.1'

10,000 cfs

$$h = 13.3$$

Downstream elevation = 65.6' (> Midpoint of 63')

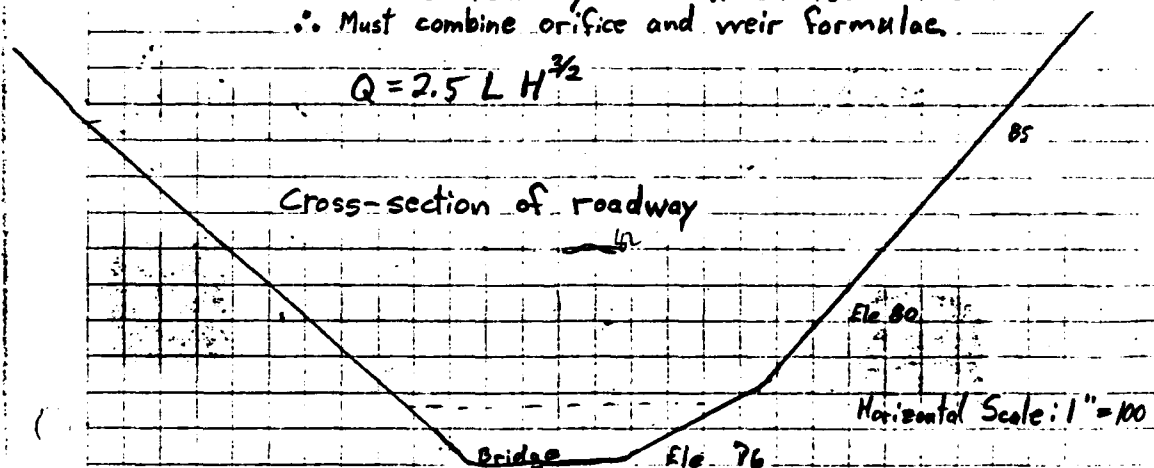
Upstream elevation = 65.6' + 13.3' = 78.9'

This exceeds roadway elevation of 76'

∴ Must combine orifice and weir formulae.

$$Q = 2.5 L H^{3/2}$$

Cross-section of roadway



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Try $H = 0.25$

$$Q_{ORIFICE} = 9990$$

$$Q_{WEIR} = 36$$

$$Q_{TOTAL} = 10,026$$

Try $H = 0.0$

$$Q_{ORIFICE} = 9900$$

$$Q_{WEIR} = 0$$

$$Q_{TOTAL} = 9900$$

Interpolating, $\frac{10,000 - 9900}{10,026 - 9900} \times 0.25 = 0.20$

$$H = 0.20$$

$$\text{Elevation} = 76.2 \text{ (WSE)}$$

20,000 cfs

Elevation of WS downstream = 71.6' (See page 6)

Try $H = 2 \text{ ft.}$

$$h = (76 + 2) - 71.6 = 6.4'$$

$$Q_{ORIFICE} = 6944 \text{ cfs}$$

$$Q_{WEIR} = 2.5 \times (115 + 245/2) \times (2)^{3/2} = 1273$$

$$Q_{TOTAL} = 8217 \text{ cfs TOO LOW}$$

Try $H = 4 \text{ ft.}$

$$h = (76 + 4) - 71.6 = 8.4'$$

$$Q_{ORIFICE} = 7956 \text{ cfs}$$

$$Q_{WEIR} = 2.5 \times \left(\frac{355 + 115}{2} \right) \times (4)^{3/2} = 4700$$

$$Q_{TOTAL} = 12,656 \text{ TOO LOW}$$

Try $H = 6 \text{ ft.}$

$$h = 10.4$$

$$Q_{ORIFICE} = 8,852$$

$$Q_{WEIR} = 2.5 \times \left(\frac{455 + 115}{2} \right) \times (6)^{3/2} = 10,472$$

$$Q_{TOTAL} = 19,324$$

(4)

20,000 cfs (continued)

Try $H = 6.5 \text{ ft.}$

$h = 10.9$

$Q_{ORIFICE} = 9,062$

$Q_{WEIR} = 2.5 \left(\frac{115 + 475}{2} \right) \times (6.5)^{3/2} = 12,222$

$Q_{TOTAL} = 21,284$ TOO HIGH

Interpolating, $\frac{20,000 - 19,324}{21,284 - 19,324} \times 0.5 = 0.17$

$h = 10.4 + 0.2 = 10.6$

WS Elevation = $10.6 + 71.6 = 82.2'$

30,000 cfs

Elevation of downstream WS elevation = $75.7'$

Try $H = 7 \text{ ft.}$

$h = (7 + 76) - 75.7 = 7.3$

$Q_{ORIFICE} = 7,417$

$Q_{WEIR} = 2.5 \left(\frac{505 + 115}{2} \right) \times (7)^{3/2} = 14,353$

$Q_{TOTAL} = 21,770 \text{ cfs}$ TOO LOW

Try $H = 9 \text{ ft.}$

$h = 9.3$

$Q_{ORIFICE} = 8,371 \text{ cfs}$

$Q_{WEIR} = 2.5 \left(\frac{605 + 115}{2} \right) \times (9)^{3/2} = 24,300$

$Q_{TOTAL} = 32,671 \text{ cfs}$ TOO HIGH

Try $H = 8.5 \text{ ft.}$

$H = 8.8 \text{ ft.}$

$Q_{ORIFICE} = 8,143$

$Q_{WEIR} = 2.5 \left(\frac{575 + 115}{2} \right) \times (8.5)^{3/2} = 20,909$

$Q_{TOTAL} = 24,052$ TOO LOW, BUT CLOSE

Interpolating, $\frac{30,000 - 24,052}{32,671 - 24,052} \times 0.5 = 0.40 - 0.13$

$H = 8.5 + 0.1 = 8.6$

WS Elevation = $8.6 + 75.7 = 84.3'$

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DETAIL Upstream From Pleasant St.
Bridge (4)

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40,000 cfs

Downstream WSE is above elevation of Pleasant St. Bridge.
Downstream WSE = 77.6
H is, therefore, measured from 77.6.

Try $H = 10'$

$$Q_{ORIFICE} = 2745 \sqrt{10} = 8,680$$

$$Q_{WEIR} = 2.5 \left(\frac{230 + 225}{2} \right) \times (10)^{3/2} = 37,750$$

$$Q_{TOTAL} = 46,430 \text{ cfs TOO HIGH}$$

Try $H = 9'$

$$Q_{ORIFICE} = 8,235$$

$$Q_{WEIR} = 2.5 \left(\frac{625 + 225}{2} \right) \times (9)^{3/2} = 30,375 \text{ cfs}$$

$$Q_{TOTAL} = 38,610 \text{ cfs TOO LOW}$$

Try $H = 9.2'$

$$Q_{ORIFICE} = 8,326 \text{ cfs}$$

$$Q_{WEIR} = 2.5 \left(\frac{690 + 225}{2} \right) \times (9.2)^{3/2} = 31,916$$

$$Q_{TOTAL} = 40,242 \text{ TOO HIGH}$$

$$\text{Interpolating, } \frac{40,000 - 38,610}{40,242 - 38,610} \times 0.2 = 0.17$$

$$H = 9.2$$

$$\text{WS Elevation} = 86.8$$

5000 cfs WSE downstream from dam = 66.1' MSL < 72.4 (top of dam)

$$Q = 3.5 H^{3/2} L$$
$$L = 93 \text{ ft.}$$
$$H = (5000 / 3.5 \times 93)^{2/3} = 6.2 \text{ ft.}$$
$$\text{WSE} = 72.4 + 6.2 = 78.6 \text{ ft.}$$
$$d = 78.6 - 57.4 = 21.2 \text{ ft.}$$

10,000 cfs WSE downstream from dam = 76.2' MSL

$$Q = 3.5 H^{3/2} L$$
$$H = (10,000 / 3.5 \times 93)^{2/3} = 9.8'$$
$$\text{WSE} = 76.2 + 9.8 = 87'$$

20,000 cfs WSE downstream from dam = 82.2' MSL

$$Q = 3.5 H^{3/2} L$$
$$H = (20,000 / 3.5 \times 93)^{2/3} = 15.6'$$
$$\text{WSE} = 82.2 + 15.6 = 97.8' \text{ MSL}$$

30,000 cfs WSE downstream from dam = 84.3' MSL

$$H = (30,000 / 3.5 \times 93)^{2/3} = 20.4'$$
$$\text{WSE} = 84.3 + 20.4 = 104.7' \text{ MSL}$$

40,000 cfs WSE downstream from dam = 86.8' MSL

$$H = (40,000 / 3.5 \times 93)^{2/3} = 24.7'$$
$$\text{WSE} = 86.8 + 24.7 = 111.5' \text{ MSL}$$

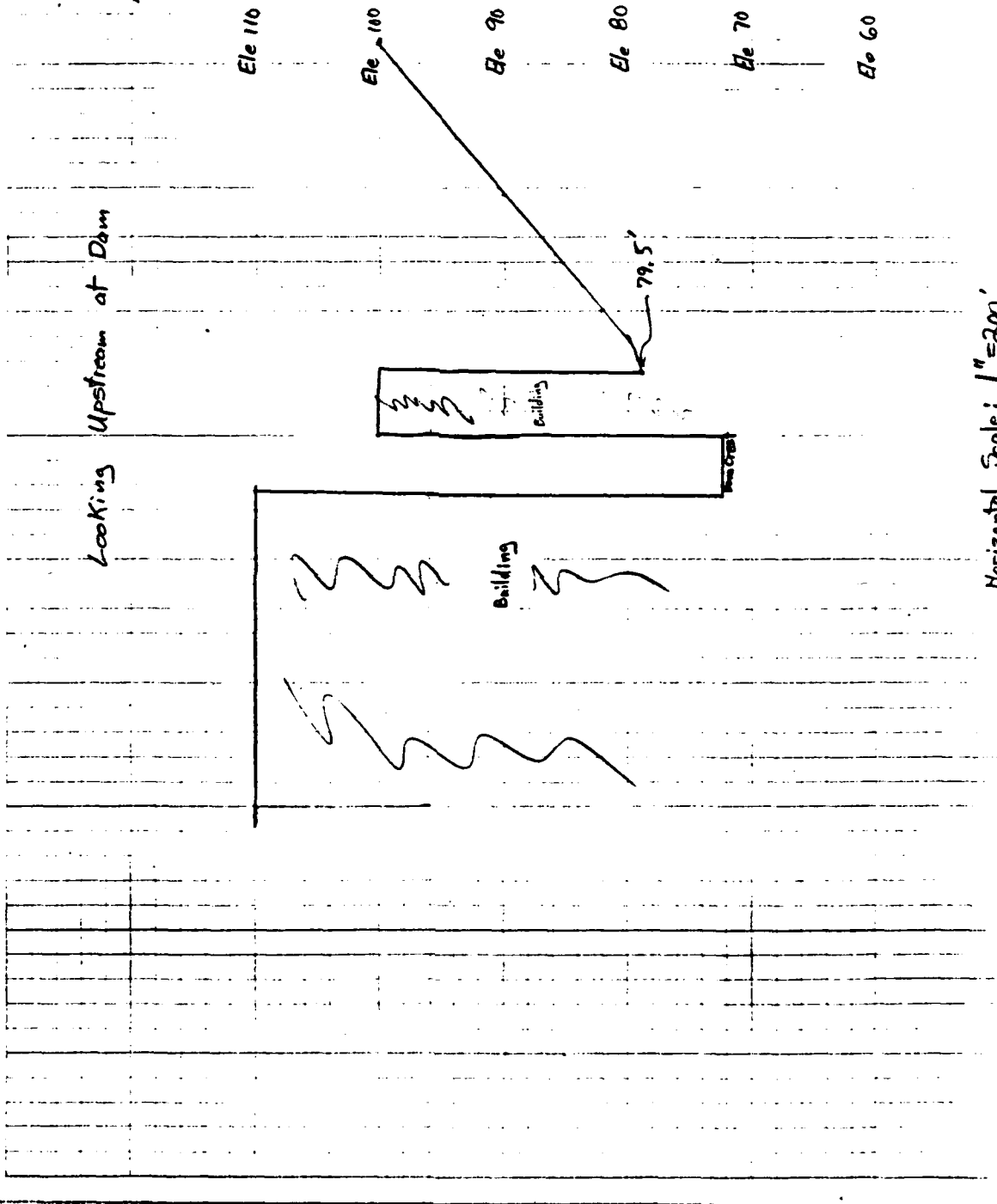
These elevations, with the exception of that corresponding to 5000 cfs, exceed the ground elevations surrounding shore-line buildings. Therefore, work with new cross-section.

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$Q = 10,000 \text{ cfs}$

Use $Q = CLH^{3/2}$
 $C = 3.5$ for dam crest
 $C = 2.5$ for surrounding area

Downstream WSE 76.2

Try $H = 6'$; WSE = 82.2 ; $H'(\text{for "LAND"}) = 82.2 - 79.5 = 2.7'$

$Q_{\text{dam}} = 3.5 \times 93 \times 6^{3/2} = 4,784$
 $Q_{\text{LAND}} = 2.5 \times \left(\frac{105}{2}\right) \times 2.7^{3/2} = 582$
 $Q_{\text{TOTAL}} = 5,366 \text{ cfs}$ TOO LOW

Try $H = 8'$; WSE = 84.2 ; $H'(\text{for "LAND"}) = 4.7'$

$Q_{\text{dam}} = 3.5 \times 93 \times 8^{3/2} = 7,365 \text{ cfs}$
 $Q_{\text{LAND}} = 2.5 \times \left(\frac{148}{2}\right) \times 4.7^{3/2} = 1,974 \text{ cfs}$
 $Q_{\text{TOTAL}} = 9,339$ TOO LOW

Try $H = 8.5'$; WSE = 84.7 ; $H'(\text{for "LAND"}) = 5.2'$

$Q_{\text{dam}} = 3.5 \times 93 \times 8.5^{3/2} = 8,066$
 $Q_{\text{LAND}} = 2.5 \times \left(\frac{148}{2}\right) \times 5.2^{3/2} = 2,372$
 $Q_{\text{TOTAL}} = 10,438 \text{ cfs}$ TOO HIGH

Interpolating, $\frac{10,000 - 9,339}{10,438 - 9,339} \times 0.5 = 0.3$

$H = 8 + 0.3 = 8.3$
WSE = 76.2 + 8.3 = 84.5

$Q = 20,000 \text{ cfs}$

Downstream WSE = 82.2

Try $H = 8'$; WSE = 90.2 ; $H' = 8' (82.2 > 79.5'; \text{ see page 17})$

$Q_{\text{dam}} = 3.5 \times 93 \times 8^{3/2} = 8,066$
 $Q_{\text{LAND}} = 2.5 \times \frac{29}{2} \times 8^{3/2} = 8,061$
 $Q_{\text{TOTAL}} = 16,127 \text{ cfs}$ TOO LOW

Try $H = 10'$; WSE = 92.2

$Q_{\text{dam}} = 3.5 \times 93 \times 10^{3/2} = 10,293$
 $Q_{\text{LAND}} = 2.5 \times \frac{29}{2} \times 10^{3/2} = 10,870 \text{ cfs}$ TOO HIGH

Try $H = 9.7'$
 $Q_{\text{TOTAL}} = 20,029$ CLOSE ENOUGH

$H = 9.7'$
WSE = 9.7 + 82.2 = 91.9' MSL

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$$Q = 30,000 \text{ cfs}$$

$$\text{Downstream WSE} = 84.3$$

$$\text{Try } H = 11'; \text{ WSE} = 95.3$$

$$Q_{\text{DAM}} = 3.5 \times 93 \times 11^{3/2} = 11,875$$

$$Q_{\text{LAND}} = 2.5 \times \frac{375}{2} \times 11^{3/2} = 18,013$$

$$Q_{\text{TOTAL}} = 29,889 \quad \text{CLOSE ENOUGH}$$

$$\text{WSE} = 11 + 84.3 = 95.3' \text{ MSL}$$

$$Q = 40,000 \text{ cfs}$$

$$\text{Downstream WSE} = 86.8' \text{ MSL}$$

$$\text{Try } H = 12'; \text{ WSE} = 98.8$$

$$Q_{\text{DAM}} = 3.5 \times 93 \times 12^{3/2} = 13,530$$

$$Q_{\text{LAND}} = 2.5 \times \frac{420}{2} \times 12^{3/2} = 25,461$$

$$Q_{\text{TOTAL}} = 38,991$$

$$\text{Try } H = 12.5'; \text{ WSE} = 99.3$$

$$Q_{\text{DAM}} = 3.5 \times 93 \times 12.5^{3/2} = 14,385$$

$$Q_{\text{LAND}} = 2.5 \times \frac{525}{2} \times 12.5^{3/2} = 27,098$$

$$Q_{\text{TOTAL}} = 42,283$$

$$\text{Interpolating } \frac{40,000 - 38,991}{42,283 - 38,991} \times 0.5 = 0.15$$

$$H = 12.2'; \text{ WSE} = 99.0'$$

APPENDIX E - INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS

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INVENTORY OF DAMS IN THE UNITED STATES

(1) ENTITY NUMBER	(2) DIVISION	(3) STATE	(4) COUNTY	(5) DIST.	(6) CONGR. DIST.	(7) NAME	(8) LATITUDE (NORTH)	(9) LONGITUDE (WEST)	(10) REPORT DATE DAY	(11) MONTH	(12) YEAR
MA	NSH	NED	MA	017	05	PLEASANT STREET DAM	4239.9	7119.4	05	JUL	79

(13) POPULAR NAME	(14) NAME OF IMPONDMENT
BEAVER BROOK	BEAVER BROOK

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	05	BEAVER BROOK	LOWELL	0	91177

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCT. HEIGHT (FT.)	(25) HYDRAUL. HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES (ACRES-FT.)	(27) DIST OWN	(28) FED R	(29) PRV/FED	(30) SCS A	(31) VER/DATE
PGGR	1850	0	19	19	140	80	NED	N	N	N

(32) REMARKS
23-NO PURPOSE 22-APPROX

(33) D/S HAS	(34) SPILLWAY	(35) MAXIMUM DISCHARGE (CFS)	(36) VOLUME OF DAM (CY)	(37) POWER CAPACITY (MW)	(38) INSTALLED	(39) PROPOSED	(40) NAVIGATION LOCKS
2	93 U	93	2500	1500			LENGTH WIDTH DEPTH NO. LENGTH WIDTH DEPTH NO. LENGTH WIDTH DEPTH NO.

(41) OWNER	(42) ENGINEERING BY	(43) CONSTRUCTION BY
GOLDCOFF REALTY, INC.		

(44) DESIGN	(45) CONSTRUCTION	(46) OPERATION	(47) MAINTENANCE
NONE	NONE	NONE	MA DPW

(48) INSPECTION BY	(49) INSPECTION DATE DAY	(50) MONTH	(51) YEAR	(52) AUTHORITY FOR INSPECTION
MALEY + ALDRICH, INC.	08	MAR	79	PUBLIC LAW 92-367

(53) REMARKS
34-ESTIMATED

END

FILMED

7-85

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